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WETLAND TRENDS AND FACTORS INFLUENCING WETLAND USE IN THE AREA INFLUENCED BY THE LOWER MISSISSIPPI RIVER: A CASE STUDY

Prepared for

UNITED STATES CONGRESS
OFFICE OF TECHNOLOGY ASSESSMENT

by

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This report is one of ten regional case studies that was funded by the Office of Technology Assessment (OTA) of the U.S. Congress for use in its study, "Wetlands: Their Use and Regulation." The views expressed do not necessarily represent those of OTA. Because of regional variations in wetlands use throughout the United States, the findings made in this report may not reflect national trends that are described in the OTA report. This report has neither been reviewed nor approved by OTA's Technology Assessment Board.

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WETLAND TRENDS AND FACTORS INFLUENCING WETLAND USE IN THE AREA INFLUENCED BY THE LOWER MISSISSIPPI RIVER: A CASE STUDY.

OVERVIEW

The importance of wetlands (inland and coastal) for providing the following "goods and services" has been documented in an extensive literature: water storage, flood control, nutrient assimilation and cycling, pollutant sequestering, maintenance of water quality and oxygen balance in aquatic ecosystems, food energy for aquatic food webs, critical habitat for waterfowl and other wildlife, recreational area, and, in the case of coastal wetlands, dissipation of storm energy, and a nursery ground for estuarine-dependent fishery species. However, the full significance of the importance of wetlands is not understood very well by the public at large and by some regulatory officials. A major portion of the total coastal and river valley wetlands in the United States is located in the area affected by the lower Mississippi River, including portions of Texas, Louisiana, Mississippi, Arkansas, Missouri, Tennessee, and Kentucky. These wetlands have declined precipitously in area during the last century. The net loss of wetlands in the lower Mississippi valley and northern Gulf coast since the 18th century total over 20 million acres, and the loss continues today.

The present document was prepared for the United States Congress Office of Technology Assessment, which is currently assessing the usefulness and effectiveness of the various federal and state wetlands regulations. This report deals with the effectiviness of these regulatory programs in Texas, Louisiana, and Mississippi. A principal focus of the overall OTA study is the permit program for the discharge of dredged or fill material into waters of the United States, at specified disposal sites, which is administered by the U.S. Army Corps of Engineers under authority of Section 404 Clean Water Act pursuant to guidelines issued by the Administrator of EPA. In the coastal portions of Texas, Louisiana, and Mississippi, the permit program administered by the COE pursuant to Section 10 of the Rivers and Harbors Act of 1899, which deals with activities affecting the course, condition, or capacity of navigable waters, is also important for oil and gas activities, but, overall, the Section 404 program is more significant in these three states.

Four tasks are to be addressed in the complete report. The primary objective of Task 1 is to document the present "state" of the wetlands in the study area. This includes wetland area, distribution by type, historical and present use, current rate of loss, and reasons for this loss. The objective of Task 2 is to outline the framework of legal/institutional regulations and socioeconomic factors that affect wetland use. The objectives of tasks 3 and 4 are to examine the relative utility of the existing wetland management framework and to compile suggestions for its improvement.

TASK 1.

HISTORICAL AND CURRENT STATUS OF WETLAND AREAS IN THE MISSISSIPPI RIVER ALLUVIAL FLOODPLAIN, THE MISSISSIPPI DELTAIC PLAIN REGION, AND THE MISSISSIPPI CHENIER PLAIN REGION

by

L. M. Bahr, Jr.

This report (Task 1) primarily consists of a description of wetlands in the broad multi-state area affected by the lower Mississippi River. The description includes a brief account of the present distribution, quality, and rates of change of these wetlands, and the ecological and socioeconomic factors that relate to this change.

Task 1 includes five objectives, as follow:

1) to define the generic term "wetland," as it is used throughout this report, and to describe the various types of wetland communities that are found within the study area;

2) to describe the three major geographic units that make up the study area, and to document the historical and present area, and distribution by type of wetland habitats in each unit;

3) to summarize current scientific thinking about reasons for the observed rapid wetland loss in the study area, including physical, biological, and socioeconomic factors, and to estimate the relative importance of each factor;

4) to outline the history of man's use of wetlands in the study area and the development of the institutional and cultural framework under which this use has occurred; and

5) to assess the overall impacts of wetland use, and the prognosis for the future, with, for example, inevitable increases in the prices of oil and natural gas.

I. WETLAND DEFINITION AND TYPES OF WETLANDS

The term "wetland" connotes many different habitats. A very inclusive classification of wetlands is that of Cowardin et al. (1979), which defines as wetland habitat shallow open water bodies, submergent grassbeds, mudflats, bogs, and other systems, in addition to marshes and forested wetlands. The U.S. Army Corps of Engineers (COE) has used a definition for wetlands as follows: "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." There has been some disagreement about the meaning of the term "prevalence" in this definition, however, and whether it implies vegetation that REQUIRES hydric soils for survival (Tripp 1979). Where a particular area is in question, the optimal way for determining its status as wetland or upland is to include vegetation, ground and surface water conditions, precipitation, soils, geology, and topography (Tripp 1979). The definition of wetlands is critical, in that a slight change in definition can drastically alter the total acreage included under the existing regulatory framework. This is especially important for the forested wetland category.

The term "wetland" as used throughout this report is defined as emergent vegetative habitats, areas that are subject to flooding or to saturated soil conditions on an occasional-to-frequent basis, and that are colonized by plants whose stems and leaves protrude above the water level during average inundation periods. Wetland emergent plants are tolerant of soil that is saturated during at least part of a year. Saturated soils quickly become anerobic, or oxygen deficient, and flood tolerant plants have the physiological capability of surviving this stressful condition for varying lengths of time.

The ecologically and functionally important aspect of emergent wetland plants is that they have evolved mechanisms that utilize the characteristic variation in water level that occurs in coastal and riverine wetland habitats as a supplementary energy source, or subsidy. Wetlands have been called "fluctuating water level ecosystems" (Odum 1969) because of their ability to take advantage of cycles of water level change (tidal and/or seasonal) to increase their rates of primary production. Flooding waters subsidize wetland productivity with nutrients and sediments, and open up new habitat to aquatic organisms (Gosselink et al. 1982). This ability is one reason for the generally high productivity of wetland communities relative to most terrestrial and/or aquatic communities. Any artificial change to a wetland zone that impairs the free flow of water will alter the cycle of water level change, reduce the energy subsidy, and thus reduce natural productivity within the altered area. Much of the observed wetland loss in the study area is related to this principle.

Wetlands in the study area can be classified into the following three general types: (1) forested wetlands (including bottomland hardwoods, swamp forests, and shrub swamps), (2) freshwater marshes, and (3) intermediate, brackish, and saline marshes. Each of these categories is described below.

Forested Wetlands. Forested wetlands is a broad and poorly defined category that includes a variety of woody plant communities subject to varying degrees of flooding. Among the number of trees found in flood-prone areas, a wide range of flood tolerance is observed. Teskey and Hinckley (1977) divided the species of bottomland trees in the Southern Forest Region into four categories of flood tolerance: (1) very tolerant trees, that can withstand flooding for two or more growing seasons, and that show good root growth during flooding; (2) tolerant trees that can withstand flooding for most of one growing season, with some root growth; (3) intermediately tolerant trees that can survive flooding for one to three months with few if any roots produced; and (4) intolerant trees that can only withstand flooding for one month or less during their growing season. Table 1, from Teskey and Hinckley (1977), shows which trees belong to each category.

The drier portion of the forested wetland spectrum is occupied by the bottomland hardwood community, which includes a number of flood tolerant trees such as sweetgum, hackberry, cottonwood, red maple, sycamore, bitter pecan, elm, ash, and several species of oaks. These areas are usually dry during the summer and fall (MacDonald et al. 1979). The ecological function of the bottomland hardwood community has been described in several publications recently, including Clark and Benforado (1981), Wharton et al. (1982) and Gosselink et al. (1982). The latter paper uses the term "riparian forest" as synonymous with the bottomland hardwood forest community.

The lower and wetter end of the forested wetland hydrological spectrum is occupied by a community known as the deep swamp forest, including some very flood tolerant species. This community is dominated by a mixture of baldcy-

Table 1. Southern forest species of woody plants and their flood tolerance. (From Teskey and Hinckley 1977).

Very Tolerant

buttonbush (Cephalanthus occidentalis)
swamp privet (Forestiera acuminata)
green ash (Fraxinus pennsylvanica)
deciduous holly (Ilex decidua)
water tupelo (Nyssa aquatica)
swamp tupelo (Nyssa sylvatica var. biflora)
eastern cottonwood (Populus deltoides)
black willow (Salix nigra)
baldcypress (Taxodium distichum)

Tolerant

boxelder (Acer negundo)
red maple (Acer rubrum)
silver maple (Acer saccharinum)
persimmon (Diospyros virginiana)
sweetgum (Liquidambar styraciflua)
blackgum (Nyssa sylvatica)
swamp ironwood (Planera aquatica)
sycamore (Platanus occidentalis)
swamp white oak (Quercus bicolor)
overcup oak (Quercus lyrata)
bur oak (Quercus macrocarpa)
water oak (Quercus nigra)
Nuttall oak (Quercus nuttalii)
willow oak (Quercus phellos)
winged elm (Ulmus alata)
American elm (Ulmus americana)

Intermediately Tolerant

river birch (Betula nigra)
ironwood (Carpinus caroliniana)
water hickory (Carya aquatica)
pecan (Carya illinoensis)
catalpa (Catalpa speciosa)
sugarberry (Celtis laevigata)
hawthorn (Crataegus spp.)
pumpkin ash (Fraxinus profunda)
honey locust (Gleditsia triacanthos)
mulberry (Morus rubra)
slash pine (Pinus elliottii)
loblolly pine (Pinus taeda)
southern red oak (Quercus falcata)
Shumard oak (Quercus shumardii)

Intolerant

pawpaw (Asimina triloba)

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pignut hickory (Carya glabra)
flowering dogwood (Cornus florida)
American beech (Fagus grandifolia)
Christmas holly (Ilex opaca)
black walnut (Juglans nigra)
eastern redcedar (Juniperus virginiana)
yellow poplar (Liriodendron tulipifera)
hornbeam (Ostrya virginiana)
shortleaf pine (Pinus echinata)
black cherry (Prunus serotina)
white oak (Quercus alba)
cherrybark oak (Quercus falcata var. pagadaefolia)
blackjack oak (Quercus marilandica)
swamp chestnut oak (Quercus michauxii)
chinkapin oak (Quercus muehlenbergii)
chestnut oak (Quercus prinus)
northern red oak (Quercus rubra)
post oak (Quercus stellata)
black oak (Quercus velutina)
black locust (Robinia pseudoacacia)
sassafras (Sassafras albidum)

press and water tupelo, with buttonbush and swamp privet, but it may also include (in local pockets of slightly higher elevation) red maple, pumpkin ash, black willow, and water elm, as well as other species. Despite its flood tolerance, deep swamp forest requires occasional drying periods for normal function. Although established swamp forest areas can tolerate permanently flooded soils, the replacement of dead or harvested trees requires a soil drying period in order for new seedlings to develop, and for nutrient cycling to operate normally. In a swamp system impounded since the 1950's, Conner et al. (1981) observed that the canopy had opened up, some species had died out, and total productivity had declined. Figure 1 illustrates the relationship between flooding frequency and productivity of forested wetlands.

An additional forested wetland habitat occurs marginally within the coastal zone of Louisiana. This is the relatively very small coastal area dominated by the black mangrove, which is salt tolerant. Mangrove habitat is geographically as well as physiologically distinct from freshwater swamp forest, and it occurs only at the southernmost edge of the study area, inside of the barrier islands. The mangrove fringe along the northern Gulf coast is especially important because it provides protected nesting sites for wading birds in the form of small islands.

Freshwater marshes occur on soils that may be slightly lower than swamp forest areas, or that are for some reason more-or-less permanently saturated, although water level variation is still necessary for normal marsh function. Freshwater marshes are characterized by a wide variety of non-woody vascular plants such as maidencane, alligator weed, bulltongue, pickeral weed, and cattails.

Intermediate, brackish and saline marshes are distinct from freshwater marshes in that they are characterized by a

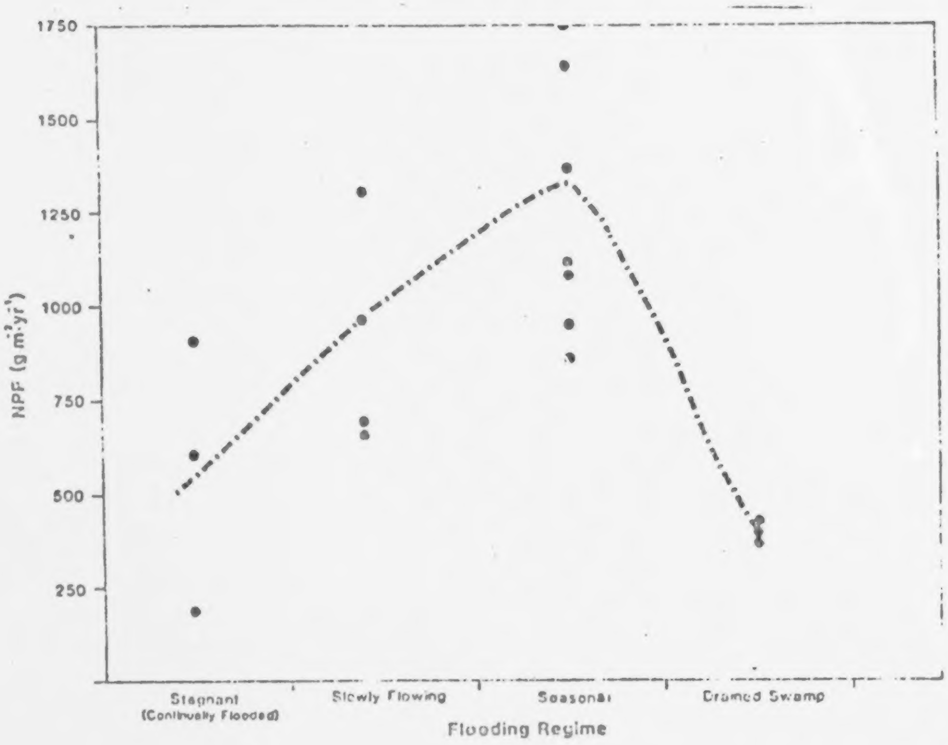

Figure 1. Relationship between flooding regime and net primary productivity in wetland forested areas. (From Gosselink et al. 1981).

variety of plants with a wide range of tolerance for brackish or saline water. These marshes are subjected to increasing inundation frequencies on a transect approaching the coast, because of increasing marine influence (tides and storms). Salt tolerant marshes typically contain fewer plant species than do freshwater marshes, and they are commonly dominated by smooth cordgrass (Spartina alterniflora, wiregrass (Spartina patens), and salt grass (Distichlis spicata) but include also black rush, and three cornered grass, among other species at the lower end of the salinity tolerance range.

Just as all wetland communities take advantage of the supplementary energy source represented by fluctuating water levels, so salt tolerant wetlands use the osmotic "stress" normally associated with salts as an additional energy subsidy to limit competition and disease (Odum et al. 1974). For example, the brackish marsh community, which is found in an intermediate salinity and intermediate flooding frequency zone, is the most productive of all the wetland communities in the study area (Hopkinson et al. 1978).

II. REGIONAL DESCRIPTIONS

The entire area affected by the lower Mississippi River falls into three distinct geographic regions; these are: I. The Mississippi River Alluvial Valley (MRAV); II. The

Mississippi Deltaic Plain Region (MDPR); and III. The Mississippi Chenier Plain Region (MCPR). The MRAV, as defined by MacDonald et al. (1979), includes portions of the states of Louisiana, Mississippi, Arkansas, Missouri, Tennessee, and Kentucky (Figure 2). MacDonald et al. (1979) use the phrase Mississippi River Alluvial Plain, but for purposes of distinguishing this region from the deltaic plain, it is being called a valley in this report. The MDPR, as defined by Wicker et al. (1980), includes much of southeastern Louisiana and a small fringe along the coast of Mississippi (Figure 3). The MCPR, as defined by Gosselink et al. (1979), includes the southwestern Louisiana and southeastern Texas coastal zones (Figure 4).

The change in wetland area in the MRAV has been documented by MacDonald et al. (1979), and discussed by Turner et al. (1981), and Gosselink et al. (1981). Wetland inventories and habitat area change (both losses and gains) and probable causes for this change in the Chenier and Deltaic Plains have been examined recently in a number of studies, e.g., Gosselink and Baumann 1980; Craig et al. 1979; Turner and Craig 1980; Gagliano 1981; Cleveland et al. 1981; Deegan et al. 1982; Turner et al. 1982. The actual change in wetland area in each region has been derived by the interpretation and planimetry of the best aerial imagery available from different dates. Estimates of the present and historical areal extent of major wetland habitats in the three regions are shown in Table 2.

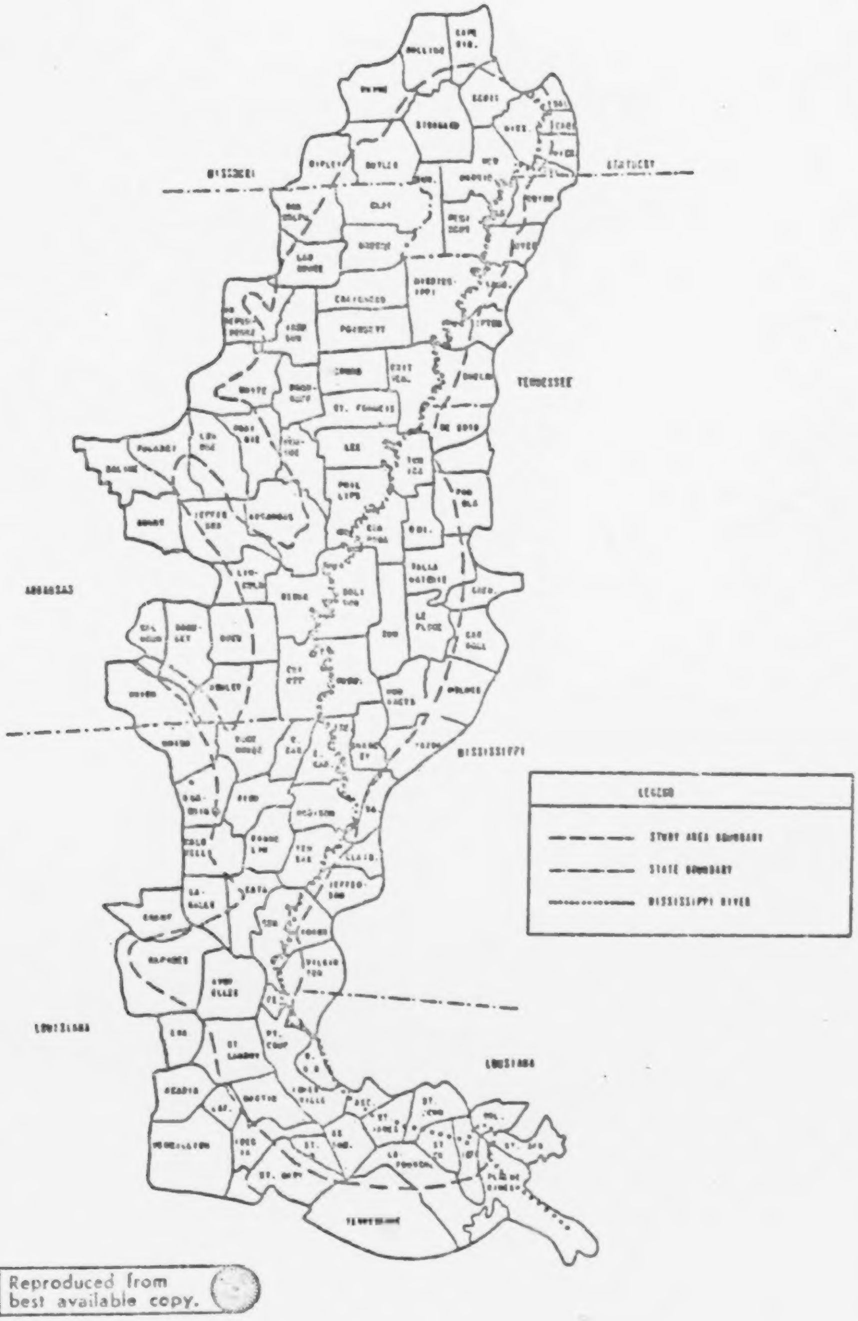
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
MISSISSIPPI
LOUISIANA
LOUISIANA
LEGEND
STUDY AREA BOUNDARY
STATE BOUNDARY
MISSISSIPPI RIVER

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Figure 2. Mississippi River Alluvia Valley (MRAV)
(from MacDonald et al. 1979).

The geological and cultural history of each of these regions will now be outlined, beginning with the MRAV.

MRAV. The Mississippi River Alluvial Floodplain occupies the alluvial valley of the lower Mississippi River and 25 other major rivers. Until fairly recently this immense valley has been subjected to an annual cycle of flooding and draining since the onset of world climatic change and sea level rise following the last ice age. This time period is relatively short from a geological standpoint. For example, Wharton et al. (1982) conjectured that the fluctuating hydrologic regime that determines the ecological function of wetland communities in alluvial floodplains arose as recently as 18,000 years ago, when a strong seasonal climatic pattern began to develop.

The MRAV is described by MacDonald et al. (1979) as being defined by steep bluffs along much of its length, and subdivided internally into basins by elevated areas. The Mississippi River bisects the entire valley along an area from Cairo, Illinois, to the Gulf of Mexico.

At the time of European settlement in this country the MRAV was a vast tract (about 10 million hectares, or 24 million acres) of primarily bottomland hardwood forest (Turner et al. 1981). By 1978, the area of bottomland hardwood that remained in the MRAV was only about 2.1 million hectares, or

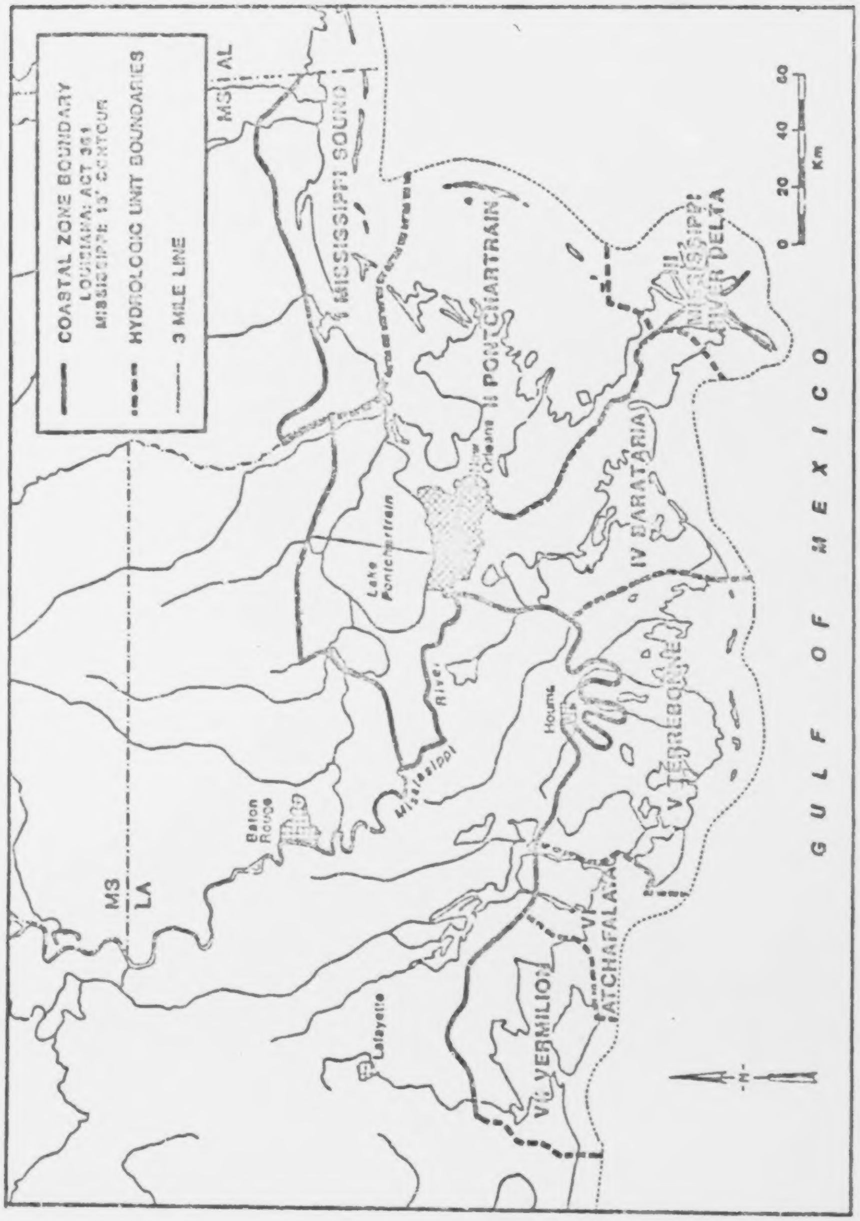
COASTAL ZONE BOUNDARY
LOUISIANA: ACT 361
MISSISSIPPI: 15' CONTOUR
HYDROLOGIC UNIT BOUNDARIES
3 MILE LINE
MS AL
MS
LA
I MISSISSIPPI SOUND
II PONTCHARTRAIN
III MISSISSIPPI RIVER DELTA
IV BARATARIA
V TERREBONNE
VI ATCHAFALAYA
VII VERMILION
Lake Pontchartrain
New Orleans
Houma
Baton Rouge
Mississippi River
Lafayette
GULF OF MEXICO
0 20 40 60
Km
N

Figure 3. The Mississippi Deltaic Plain Region (MDPR)
(from Bahr et al. MS in preparation)

21% of the original, as shown in Table 2. This area has been projected to diminish to less than 1.6 million hectares by 1995 (MacDonald et al. 1979), although if the recent rate of clearing continues, only 810,000 ha (2% of the original) will remain by the year 2000 (Gosselink et al. 1982). Most of this loss is due to clearing for agriculture. Figure 5 illustrates the proportion of original bottomland hardwood forests remaining in the MRAV in 1969. Figure 6 shows how forest loss in the MRAV is proceeding from north to south as the land is cleared for agricultural use (Gosselink et al. 1982). The rate of loss of bottomland hardwood habitat in the MRAV is the highest in any region of the country, e.g., losses of floodplains bottomland hardwoods in the Carolinas, Georgia, and northern Florida have been much less extensive (Wharton et al. 1982).

MDPR. The MDPR is a large dynamic coastal area, known for rapid geological changes. Since sea level stabilized, sediments from the Mississippi River have formed a broad coastal plain of over 3.4 million hectares. About 50% is inland water such as bays, lakes, and rivers and bayous; about 40% is swamp and marsh; and the remainder is terrestrial (primarily natural levee ridges adjacent to Mississippi River distributaries).

Although there has been an overall gradual net land gain within the MDPR during the Holocene epoch, there have

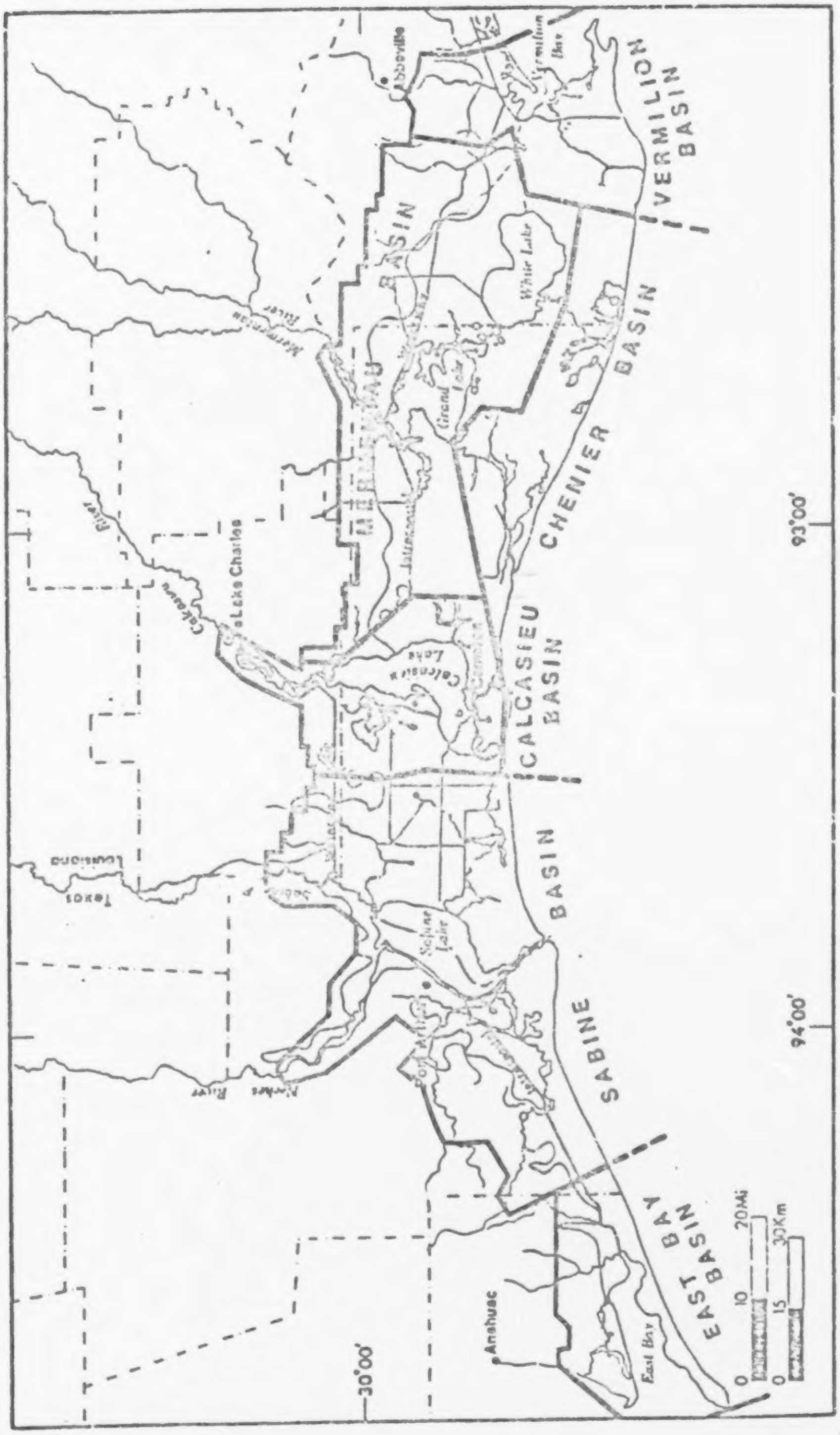
VERMILION BASIN
MERMENTAU BASIN
CHENIER BASIN
CALCASIEU BASIN
SABINE BASIN
EAST BAY BASIN
Abbeville
Vermilion Bay
White Lake
Grand Lake
Mermentau River
Lake Charles
Calcasieu River
Calcasieu Lake
Louisiana
Texas
Sabine Lake
Neches River
Anahuac
East Bay
93°00'
94°00'
30°00'
0 10 20Mi
0 15 30Km

Figure 4. The Mississippi Chenier Plain Region (MCPR) (from Gosselink et al. 1979).

Table 2. Estimates of the present and historical areal extent of major wetland habitats in the MRAV, MDPR, and MCPR (areas are in hectares).

Region and Date	Forested Wetland Area	Fresh Marsh Area	Saline Marsh Area (a)	Total Regional Area	References
MRAV					
(1700)	9.8x10E6	---	---	9.8x10E6	Turner et al. (1981); MacDonald et al. (1979)
(1937)	4,786,930	---	---	"	
(1977)	2,097,850	---	---	"	
MDPR					
(1890)	----------1.02x10E6----------			3.4x10E6	Craig et al. (1979); Wicker et al. (1980)
(1955)	(included in MRAV)	364,477	572,937	"	
(1978)		165,267	586,425	"	
MCPR					
(1952)	6,934	-----438,572------		1.3x10E6	Gosselink et al. (1979)
(1974)	6,538	116,331	202,853	"	

(a) saline, brackish, and intermediate marshes are lumped

been large scale cycles of gain and loss. Since sea level stabilization, the river has occupied seven different major courses and many minor ones, resulting in seven major deltaic lobes. The river is now in the early stages of the eighth deltaic lobe, forming in the Atchafalaya Bay area.

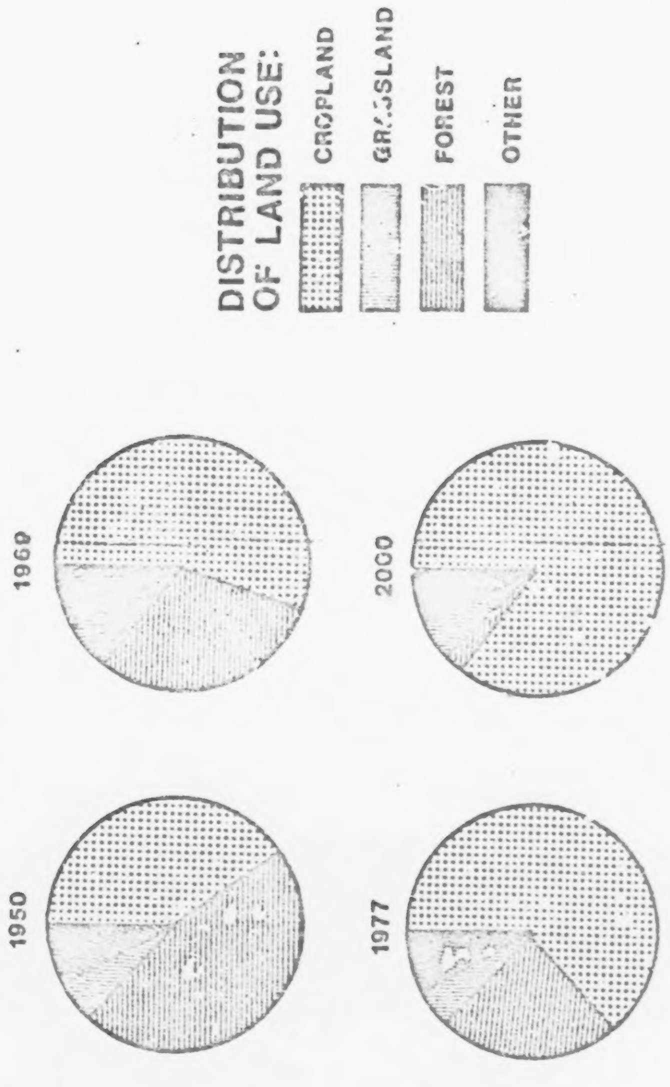

Figure 5. Distribution of land use in the MRAV (from Gosselink et al. 1981)

Figure 5 (From Gosselink et al. 1981)

During the growth phase of a lobe there is rapid progradation of land at the mouth of the channel. Land is also built by overbank flooding and infilling of older deteriorating marshes. As the channel lengthens and the gradient becomes smaller, the river will seek a new, shorter course to the Gulf. When a lobe is abandoned, local land building

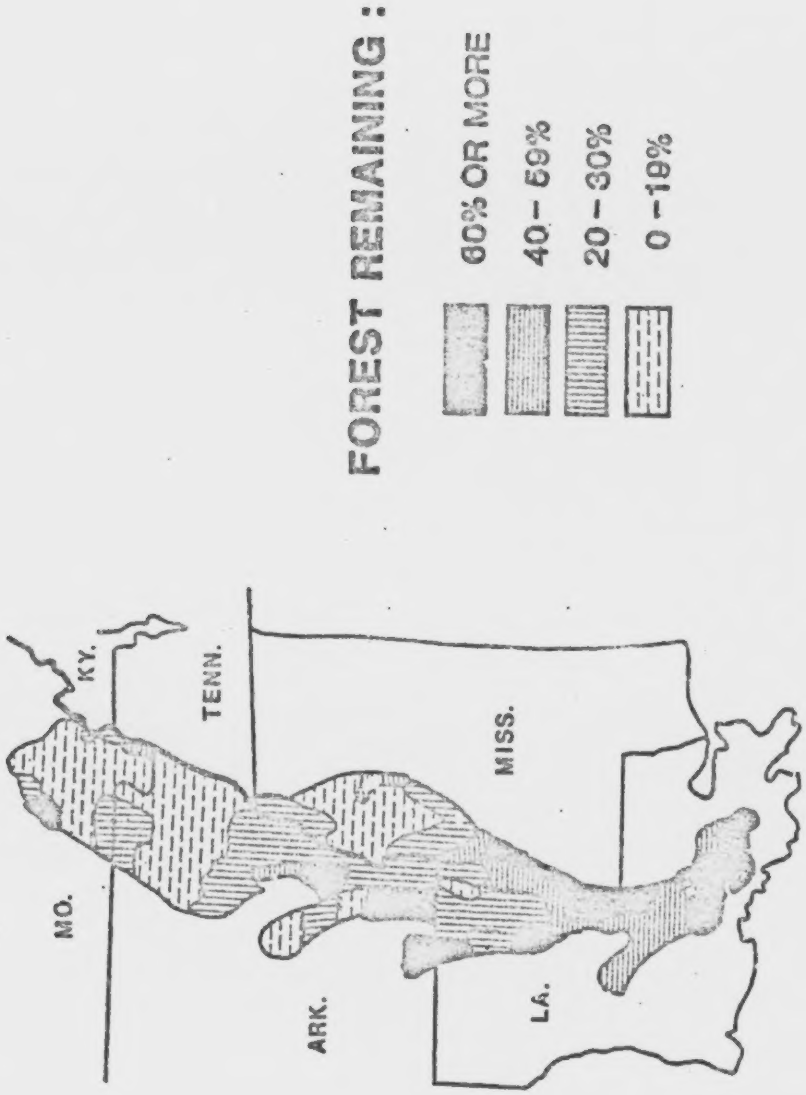
FOREST REMAINING :
60% OR MORE
40 – 59%
20 – 30%
0 – 19%
MO.
KY.
TENN.
MISS.
ARK.
LA.

Figure 6. Forested wetlands remaining in the MRAV (from Gosselink et al. 1981).

Figure 6 (From Gosselink et al. 1981)

ceases and land loss commences because of erosion and subsidence. Over the entire MDPR, the pattern has been land gain in part of the region, and loss in the remainder, with the gain slightly ahead of the loss. This pattern is shown in Figure 7.

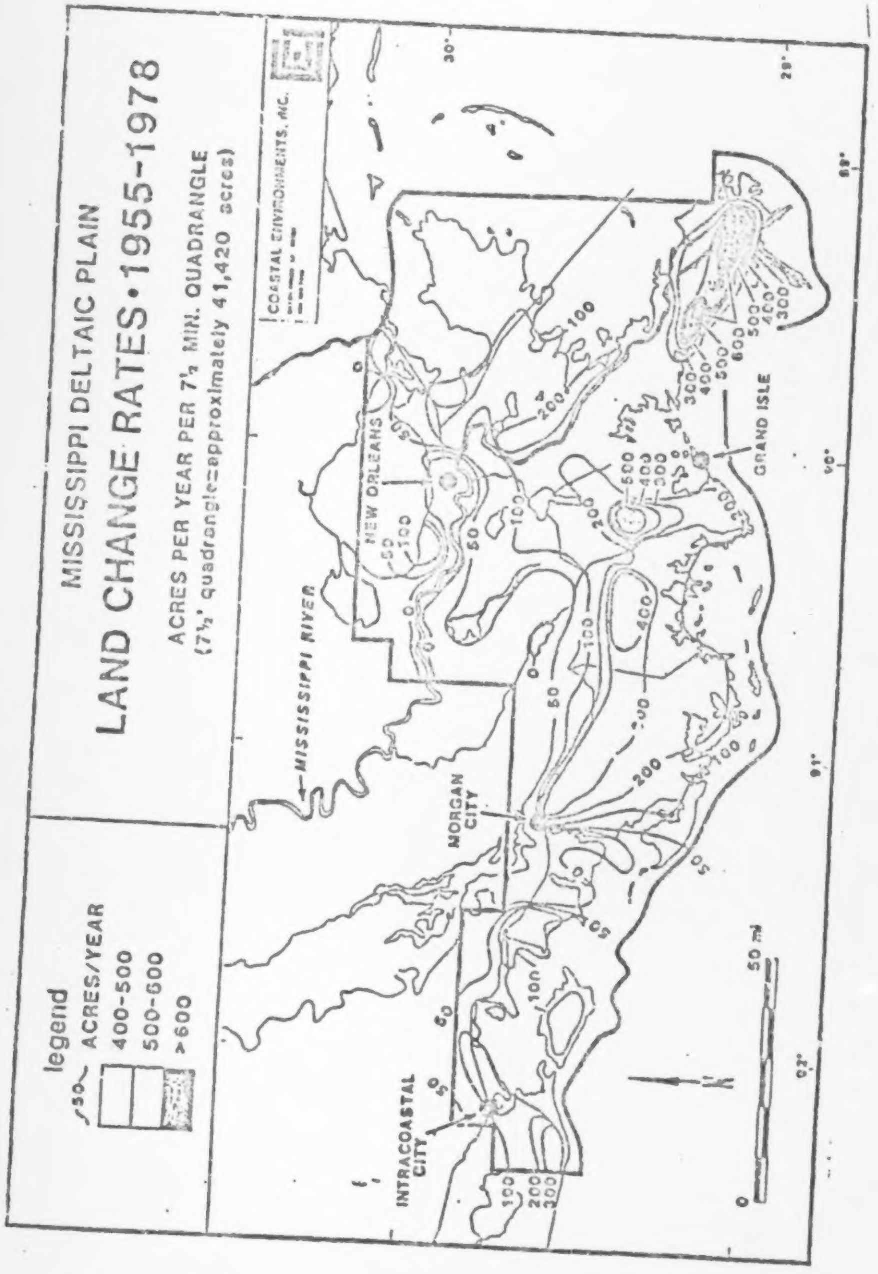
MISSISSIPPI DELTAIC PLAIN
LAND CHANGE RATES•1955-1978
ACRES PER YEAR PER 7½ MIN. QUADRANGLE
(7½' quadrangle=approximately 41,420 acres)
legend
50 ACRES/YEAR
400-500
500-600
>600
COASTAL ENVIRONMENTS, INC.
MISSISSIPPI RIVER
NEW ORLEANS
MORGAN CITY
GRAND ISLE
INTRACOASTAL CITY
30°
29°
89°
90°
91°
92°
0
50 mi
N
50
100
200
300
400
500
600

Figure 7. Land loss rates in the MDPR (from Gagliano et al. 1981).

The most recent sequence in this cycle involves the Atchafalaya River, a distributary of the Mississippi to the west of the main trunk, that is diverting much of the flow to the gulf in a pathway about 300 km shorter than the mainstream. By the late 1950's the Atchafalaya River had captured enough of the flow of the lower Mississippi River to alarm the U.S. Army Corps of Engineers, and a control structure was completed in 1963 to limit the diversion to about 30% of total flow. This (Old River) control structure, which is presently being upgraded, has prevented the abandonment of the present lower Mississippi channel on which the Ports of Baton Rouge and New Orleans depend. Nevertheless, the Atchafalaya subdelta is aggrading rapidly in Atchafalaya Bay, which is now the only basin in the MDPR in which deposition and land gain is exceeding land loss (c.f., Baumann and Adams 1982).

Nevertheless, the overall pattern of slow net land gain has been interrupted. Cheap, abundant fossil fuel has given man the power to override some natural processes, especially the flow of the Mississippi River. Thus it is clear that if the lower Mississippi course and flooding cycle were unmodified and unregulated the recent history of wetland loss would not have been so severe. A description of the ongoing change (loss) in wetlands in the MDPR thus requires a discussion of the interactions among natural and cultural phenomena.

Craig et al. (1979) defined land loss "as the substantial removal of land from its ecologic role under natural conditions." Impoundment or filling of wetlands does not eliminate an area of land (i.e., by converting it to water), but it does eliminate the ecological function of the wetland. In this report wetland loss includes its conversion to water or to dry land.

Man's control over both the annual overbank flooding cycle of the Mississippi River and the long term river diversion cycle have altered the pattern of continuous land building in the MDPR. There has been a dramatic shift in the MDPR from a net gain of land to a net loss (Gagliano and van Beek 1970; Craig et al. 1979; Adams et al. 1976; and Gagliano et al. 1981). The rate of loss is accelerating and the latest estimate is 39.4 sq mi (102 km) annually for the MDPR. This is discussed further in Section III.

MCPR. The Mississippi Chenier Plain Region is a coastal plain that is named for its only naturally occurring relief features, a series of linear beach ridges paralleling the shoreline. These ridges are known as cheniers, after the French word "cheniere" for oak tree. Cheniers in the MCPR are dominated by live oak trees, which stand out strongly in contrast with the low marsh that surrounds them.

Geologic development of the MCPR began approximately 3,000 years before present (B.P.) via westward littoral transport of active and eroding Mississippi deltaic sediments, combined with deposition of local fluvial sediments (Howe et al. 1935; Van Lopik and McIntyre 1957; Byrne et al. 1959). Development of recessional beach ridges coincides with the eastward shifts in the course of the Mississippi River, whereas intervening mudflats are associated with westward shifts in the river's course (Byrne et al. 1959; Gould and McFarlan 1959).

Wetland development in the MCPR occurred under somewhat different conditions than those in the MDPR (see below); e.g., the two coastal regions differ in their tidal regimes and freshwater inputs. They also differ because of the cheniers in the MCPR that tend to block the exchange of water between the wetlands and Gulf. The MCPR is also not as broad as is the MDPR, and is inherently more stable in a geologic sense due to a substantially thinner sequence of Holocene (Recent) deposits.

The cultural history of the MCPR is basically related to agriculture in the form of cattle and rice culture, although the rice growing area is mostly north of the MCPR in what is known as the Prairie Region. Because the Louisiana portion of the MCPR was not originally a part of the Louisiana Purchase its ownership was somewhat up for grabs, with the Spanish and French both claiming authority for a time. Just over 100 years ago the MCPR had very few permanent residents, many of whom had migrated eastward from the Texas region, with cattle ranching as part of their culture. The MCPR, with its large expanses of wetlands, has always been only marginal for cattle grazing, and some migrants from the midwest tried pig culture, but the latter practice never really caught on (Kniffen 1972). Wetlands in the MCPR are strongly affected by cattle grazing. A network of cattle walks has been created throughout the marshes to allow the use of these grasslands during relatively dry periods. Marsh burning is also widely practiced, with the aim of increasing the productivity of certain grasses, both for cattle and for furbearing animals.

To this day the MCPR is primarily rural and agrarian with a low population density because the only suitable site for residential and commercial development are the cheniers. Major population centers occur just to the noth of the MCPR, however, and these regions have had profound effects on the region, in terms of hydrologic changes due to the construction of navigation channels and impoundments, pollution, and freshwater extraction from both surface and groundwater.

At present oil and gas extraction is the dominant socioeconomic activity in terms of dollars generated, with sport fishing and hunting, agriculture, and commercial fishing and fur trapping in decreasing order of importance but all far behind oil and gas. , (Gosselink et al. 1979).

Aquaculture, especially crawfish farming in wetland impoundments, may become more important in the future (see Aquaculture subsection).

III. WETLAND LOSS AND ITS CAUSES IN THE THREE REGIONS

MRAV. The total area of wetland (bottomland hardwood) lost in the Mississippi River Alluvial Floodplain in the recent past is shown in Table 2. This loss was documented for each 10-year interval from 1937 to 1977 in a study from which the following discussion on the MRAV was excerpted (MacDonald et al. 1979). They attempted to explain the reasons for the overall loss, as well as differences in loss rates among different MRAV zones.

The most probable explanations for the loss of wetland in the MRAV were identified as: (1) direct economic advantages of using bottomland for agriculture rather than for timber production, hunting, and other potential uses of forested wetland; (2) natural changes in hydrologic conditions in the whole MRAV or in local areas (i.e., abnormally extended dry periods that may have increased the potential for agricultural conversion); and (3) man-made hydrologic changes, such as flood control and drainage projects that may have created suboptimal conditions for wetlands, and induced agricultural projects. For example, the U.S. Army Corps of Engineers, the U.S. Department of Agriculture, and the U.S. Soil Conservation Service completed a total of 302 flood control, drainage, and other projects within the MRAV between 1937 and 1977 (MacDonald et al. 1979).

MacDonald et al. (1979) showed that the loss of wetlands over time has been accompanied by an almost equivalent increase in agricultural area. The increase in land cleared for agricultural purposes between 1937 and 1977 was estimated at over 2 million hectares, while the simultaneous decrease in bottomland hardwood area was almost 2.7 million hectares. Most of this altered land has been planted in soybeans. In the MacDonald et al. study it was found that land clearing rates by county in northern Louisiana and Mississippi were positively related to drought incidence. In addition, man-induced hydrologic alterations in different areas of the MRAV corresponded with local rates of wetland clearing, but this relationship was also qualitative and not rigorous. The study shows, however, that neither natural nor man-caused hydrologic changes would have led to increased land clearing, had the world demand for soybeans not boomed relative to other crops during the period from 1937-77. Nowhere is the significance of this conversion of land from wetland to agriculture more dramatically illustrated than in the delta area of Mississippi (within the MRAV), where bottomland hardwoods were reduced by 60% from 1970 to 1976 (Hirsch and Segelquist 1978).

Of particular interest to the management of the remaining parcels of bottomland hardwoods in the MRAV is the fact that the largest remaining areas are in Louisiana. MacDonald et al. (1979) clearly showed that, whereas wetland clearing had peaked in the other states by 1962, it was still increasing in Louisiana in 1972 (see Figure 8). Gosselink et al. (1982) discussed the local differences in clearing rates within the MRAV. For example, from 1960 to 1975 Arkansas and Missouri lost one half of their total bottomland hardwood forests as a result of human development. These authors comment that Louisiana still has the largest expanses of bottomland hardwood forest in the U.S., despite a steady loss since 1860, but land clearing in Louisiana has been accelerating. The Atchafalaya Basin contains the largest remaining contiguous swamp forest and bottomland hardwood areas, and soybean fields are rapidly spreading through parts of this wetland area.

The recent boom in worldwide demand for soybeans, relative to the more modest demands for timber and other direct commercial uses of bottomland hardwood forest, is the apparent reason for the remarkably rapid conversion of bottomland hardwood habitat to soybean fields. There are now some signs that this demand has at least temporarily been saturated. For example, storage capacity for soybeans in Louisiana is apparently almost nil. Some of the leveling off is presumably the result of the worldwide recession

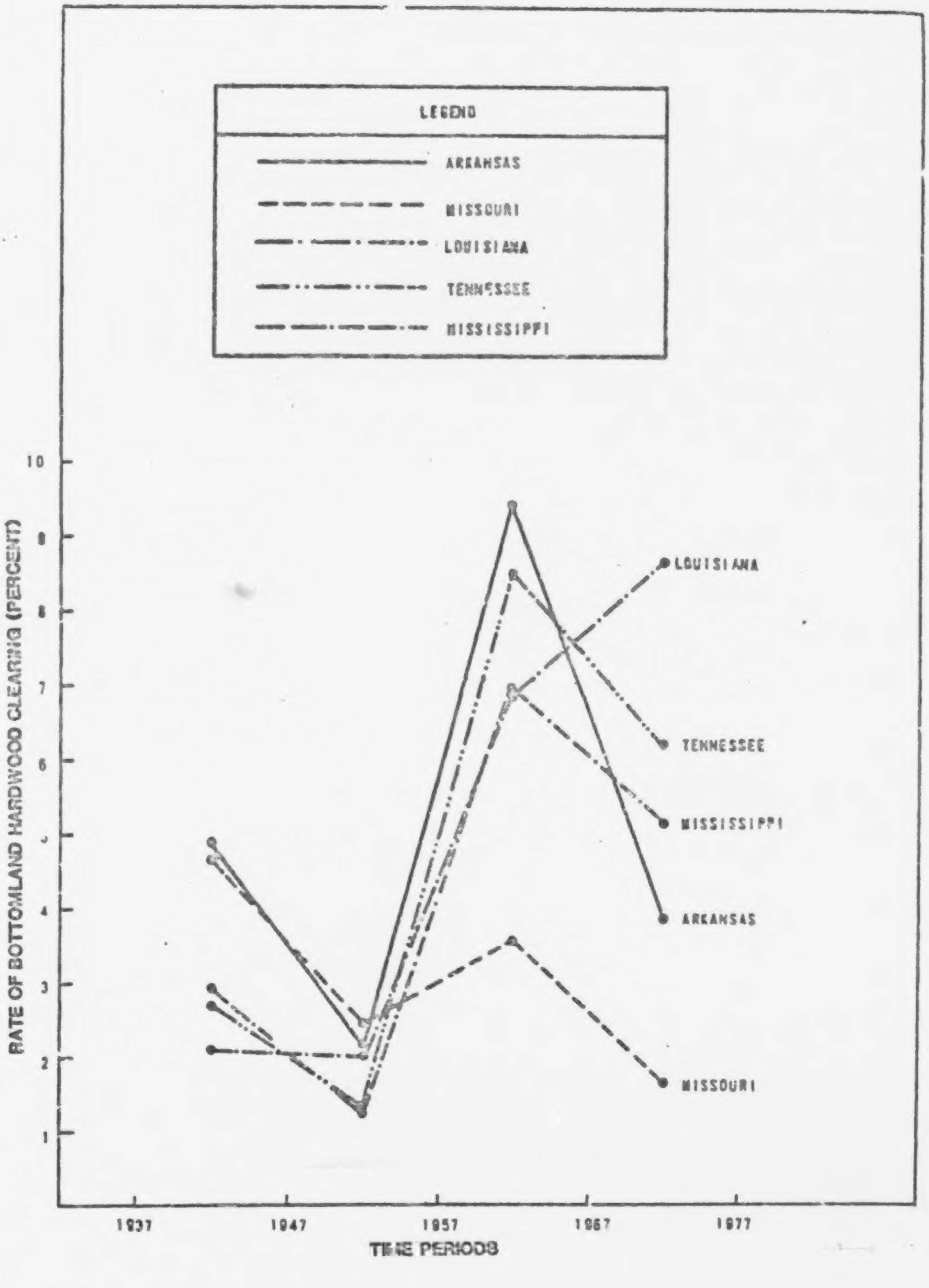

Figure 8. Rate of BLH clearing by state (from MacDonald et al. 1979).

which may ease in the future, although there are extremely persuasive arguments to suggest that the decline in economic growth, at least in the U.S., is a function of declining domestic energy production (e.g., Costanza 1980). It is difficult for a farmer who has converted to soybeans to alter his planting to follow market trends, however, because the machinery for soybean production is so expensive and specialized that it cannot be left idle or used for other crops.

MDPR. The most complex region, both from a geological standpoint, and from the standpoint of linking wetland loss to a specific set of causal functions, is the MDPR. Wetland loss is a controversial topic in this region that is extremely important for its fishery production as well as its petroleum resources. The political implications of land loss in the MDPR include the fact that a landward shift in the shoreline could result in a loss to the state of severance taxes from offshore production of oil and gas.

Land loss in the MDPR has been examined in a number of studies. Wetland loss occurs in four general ways: (1) Wetlands become open water because of natural processes, such as storm-caused erosion, subsidence, or overgrazing by birds or mammals. (2) Wetlands are directly removed by dredging to form canals, harbors, etc. (3) Wetlands are artificially covered by fill material and converted to terrestrial habitat, most commonly as a result of spoil disposal. (4) Wetlands are isolated from the rest of the coastal ecosystem by being totally or partially isolated by spoil banks (Craig et al. 1979). The natural causes of land loss are discussed first, and then cultural reasons.

Natural Land Loss. The process of land loss in the MDPR is complex. There are two major natural mechanisms: lateral erosion of shorelines, and gradual submergence of inland marshes. Wave attack is the primary cause of shoreline retreat and erosion. Lack of sufficient sediments to offset apparent sea level rise causes inland marsh loss. Increase in sea level relative to marsh level occurs because of both subsidence and actual sea level rise.

At this point it is necessary to differentiate between long term (regional) and short term (local) subsidence. The former is a tectonic process that occurs on a time scale of thousands of years. The latter occurs on a shorter time scale and may be highly variable in different nearby sites. This can be caused by excessive pumping of water, oil, and gas, especially from shallow reservoirs (Kreitler 1977).

Subsidence has occurred steadily during the past 130 years over the entire northern Gulf coast, with an apparent rate of increase during the past 30 years. From 1848 until 1959, the measured rate of subsidence from two locations in or adjacent to Barataria Basin was 0.27 and 0.63 cm per year, respectively (Swanson and Thurlow 1973). From 1959 to 1971, these rates increased at the same sites to 1.29 and 1.12 cm per year. A third location in the nearshore Gulf experienced a subsidence rate of 1.51 cm per year during the latter time period. In the most recent analysis of subsidence in the Barataria Basin, Baumann (1980) found that from 1954 to 1979, subsidence in the lower basin was 1.30 cm per year.

Thus, along the northern gulf coastline that includes the MCPR and the MDPR, there has been an apparent average rise in sea level (based on tide guage data) of about 1.2 cm/year during the past 30 years (Swanson and Thurlow 1973; Baumann 1980; Gosselink et al. 1979). This rise has been observed to decrease in an inland direction. Global increase in sea level is currently estimated at about 1.2 mm/yr (Gornitz et al. 1982). Hicks (1981) reported that sea level rise in the west Florida coastal zone (a geologically stable area) is currently about 1.4 mm/yr. These numbers indicate that only 10% of the observed change in sea level along the MDPR can be explained by global sea level rise, and that the remaining 1.1 cm/yr change is probably the result of a combination of local and regional subsidence. The recent increase in apparent subsidence rate is probably attributable to cultural processes, including the deprivation of riverine sediments to the coastal zone, thus decreasing the aggradation rate of marshes.

The decline in sediments reaching the coastal wetland zone can be attributed to two factors, the relative importance of which is still unquantified. First, the entrainment of the Mississippi River in its present course, and the prevention of overbank flooding has resulted in the sediment load being jettisoned offshore into deep water. This is a problem of disbursement, i.e., if the lost sediments could be distributed evenly across the coastal zone, some of the land loss would be reversed. Secondly, there is evidence of an absolute reduction in sediment. There has been a reported 50% decline in the total suspended sediment load of the Mississippi River system during the past 100 years (Tuttle and Combe 1981). This decline during the recent past is the presumed result of tributary damming, channel training, and land use changes throughout the drainage basin. A comparison of the sediment requirements of the coastal zone and the amount now carried by the river system would be helpful in determining the relative importance of these two components of sediment starvation.

The most important processes affected by the deprivation of riverine sediment input are the rates of sedimentation and accretion of both streamside and inland marshes. DeLaune et al. (1978) found that marsh sites near natural streams accrete at 1.35 cm per year, while inland marsh sites in the same area accrete at only 0.75 cm per year. Baumann (1980) using data from Delaune et al. (1978)

observed that much of the inland marsh in the study sites were accreting at rates less than the rate of apparent sea level rise. When compared with an apparent sea level rise of 1.2 cm/yr, it is evident that only streamside marsh is accreting fast enough to maintain its intertidal elevation. Suspended sediment must pass through the streamside marsh before it reaches the inland marsh. Boto and Patrick (1978) stated that inorganic nutrients adsorbed to sediments carried into a marsh stmulate the productivity of streamside marsh, which in turn results in increased stem density relative to inland marsh. Increased stem density presumably enhances the further trapping of sediments and nutrients.

Baumann (1980) observed similar patterns of accretion in his analysis of sedimentation from 1975 to 1979. The accretion rate of streamside marshes (1.52 cm/yr) was significantly higher than inland marsh accretion rates of 0.91 cm/yr. These sedimentation rates coincided with the observed rates of land loss in the study area. For all inland and streamside sites that had "aggradation deficit" (i.e., sedimentation rate less than apparent sea level rise), the weighted average sedimentation rate was 1.12 cm per year. Compared to the subsidence rate of 1.30 cm per year, this rate of sedimentation leaves a mean aggradation deficit of 0.18 cm per year for 80% of the salt marsh in the Barataria Basin. Baumann proposed that this deficit indicates that the lack of adequate external sediment supply may be responsible for a large part of the marsh currently being lost in the basin.

A regional shift in the source and seasonality of sedimentation in marshes also dramatically influences marsh accretion rates. During the past 5000 years, direct introduction of sediments during the spring flood supplied marshes in the active delta lobe with enough sediment to counter the effects of subsidence, and provided a surplus that enabled marsh accretion to occur. Following a shift in the course of the Mississippi River, a decrease in direct sedimentation occurs in the abandoned delta lobe. Much of the MDPR is currently comprised of abandoned delta lobes, and the construction of levees along the Mississippi River is preventing reoccupation of streams in these inactive lobes, which would promote growth and stability of brackish and salt marshes.

In comparison with U.S Atlantic coast marshes, the MDPR receives a high rate of sediment input, (although it is not enough to stay ahead of subsidence in many areas). Most of the MDPR sediment input occurs during high energy events (storms and hurricanes). These events do not introduce new sediment, but instead rework and redistribute existing bay-bottom sediments. Baumann (1980) found that 41% of all sedimentation from 1975 to 1979 in Barataria saline marsh areas occurred during the winter months of those years; 38% was the result of two tropical storms that passed through the area, and 21% occurred during the remaining months of the year.

The key to the high sedimentation rates during the winter months is storm activity. Southerly winds increase as a cold front approaches from the northwest, raising water level in the marsh, and increasing the suspended sediment load in the water. Some of this suspended material is deposited on the marsh surface. When the front passes, winds swing to a northerly direction, causing a rapid drop in water level (Baumann 1980).

To summarize, sedimentation and marsh aggradation is the opposing force to apparent sea level rise, in the overall struggle between land loss and gain in the marshes of the MDPR. The emergent area of the total MDPR has continually gained in area until recently, but with many local cycles of gain and loss.

Cultural Processes and Land Loss. A diverse array of human activities cause wetland loss in the MDPR. These include canals for oil exploration, pipelines, navigation, recreational development, drainage, and flood control. Other cultural factors related to land loss are construction of bulkheads and seawalls, highways, and impoundments, such as for aquacultural activities, but most available studies of land loss in the MDPR show a strong statistical relationship between canal density and wetland loss, and some researchers and managers feel that canals are a primary man-caused factor leading to wetland loss in the MDPR.

Canals are now a very common feature in the MDPR. Canal area (not including the area of associated spoil deposition) is about 1.4% of the Louisiana coastal zone, or about 20,200 hectares (Craig et al. 1979). Wicker et al. (1980) reported that canals comprise 0.85% of the area of the MDPR but there are some problems with the derivation of this number (Costanza et al. 1982). Canals have been constructed for a variety of purposes, including navigation, pipelines, oil and gas exploration, oil and gas well access, drainage, and borrow pits. Canals directly affect wetlands by excavation and spoil deposition. They indirectly impact wetlands by changing hydrology, sedimentation, and productivity. Canals have accelerated salinity intrusion, causing marsh vegetation loss (Van Sickle et al. 1976). Canal spoil banks limit water exchange over wetlands, and thus decrease deposition of suspended sediments. This significantly exacerbates the existing sediment deficit in inland marshes. Because sedimentation is the major source of "new" nutrients to the marshes (DeLaune and Patrick 1980), lack of sediment results in lower productivity. Craig et al. (1979) estimated that almost 70% of the total annual loss of 39.4 square miles in the MDPR (102 km2) may be the result of canals, but that 10% of the direct loss of wetlands is attributable to canals in the Barataria Basin, the area for which the best data exist. Johnson and Gosselink (1982) also estimated that canals are responsible for 10% of the direct loss of MDPR wetlands in the period 1955-1978, and 20% if spoil banks are included (see below).

Once established, canals do not stabilize, but instead tend to widen over time, especially as a result of wave action, boat traffic, and altered hydrologic patterns (Craig et al. 1979; Johnson and Gosselink 1982). The annual observed increase in canal width varies from 2% to 14%, for a doubling time ranging from 7 to 50 years. As the cross section and density of canals increases, the cross section and density of natural channels decreases, indicating altered hydrologic patterns and resulting changes in habitat from marsh to open water (Craig et al. 1979).

Spoil banks, the inevitable result of canal dredging, also lead to direct marsh destruction. Spoil is most often deposited alongside the dredged area, a practice that destroys the adjacent marsh and leads to higher elevations, preventing marsh-water exchange. One estimate of the ratio of canal area to total spoil area is 1:2.5 (Craig et al. 1979), indicating the importance of spoil deposition to direct wetland loss. The most recent estimates of canal impacts and rates of widening are found in a study by Johnson and Gosselink (1982) in which the total direct impact of a canal is shown to equal about five times the permitted width of the water surface. In the paper cited "direct" effects are defined as the immediate conversion of wetland to canals and spoil banks during construction, and the subsequent widening of canals as their banks erode through time.

Canals also have less obvious indirect effects due to such factors as salt water intrusion, altered water flow and sediment transport, eutrophication of open water bodies, and interconversions between inland and streamside marsh. One of the most subtle, yet pervasive indirect effects of canals is a decrease in marsh sedimentation. When a canal is dredged through a marsh it tends to replace natural channels as the main agent of transport through the marsh, since it is usually deeper, straighter, and faster flowing (Craig et al. 1979). The streamside marsh adjacent to the natural channel is steadily converted to inland marsh, because the natural channel no longer supplies the sediments and nutrients necessary to maintain it. Once converted to the inland type, the marsh is then subjected to the sediment deficit described above, and will eventually be converted to open water because of subsidence. Craig et al. (1979) estimated that the area of streamside marsh converted to inland marsh by this indirect mechanism is three to four times the area of streamside marsh converted directly to open water by dredging associated with canal building. The same pattern is true for the Louisiana coastal zone as a whole (Craig et al. 1979).

One problem of examining canal effects is the fact that the specific characteristics of a canal, such as its size, orientation, and the wetland habitat through which it passes, affect the ways it interacts with the surrounding wetlands (Stone and McHugh 1979). Relatively little is known about the effects of specific canal variables in this regard, and more research is obviously called for.

Several recent studies have looked at the statistical relationship between canals and land loss, by examining different parts of the Louisiana coastal zone and comparing their recent rates of land loss as a function of canal density. Scaife et al. (1982), and Turner et al. (1982) performed linear regression analyses of several variables on land loss rates. Data for these studies were canal densities on individual quadrangle sheets of the MDPR as shown in USFWS habitat maps compiled by Wicker et al. (1980). These studies concluded that canals in the MDPR have been responsible (directly and indirectly) for as much as 65% or more of the total land loss between 1955 and 1978, and that the area of new canals added each year is accelerating in the MDPR. Figure 9 shows how canal density has increased over time in the MDPR.

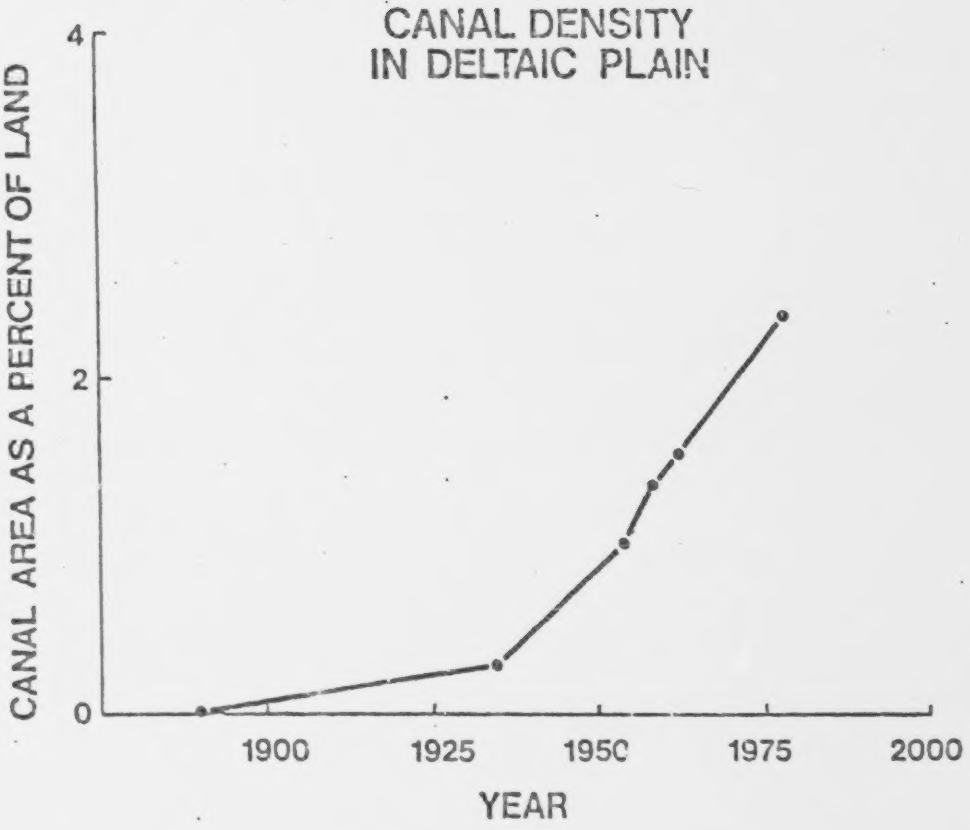

Figure 9. Increase in canal area in the MDPR over time. (from Turner et. al. 1982).

Deegan et al. (1982) followed up on these studies, performing multiple regression analyses on the same data, and are somewhat more conservative in their assessment of the relationship between canal density and land loss. Nevertheless, the latter study concludes that from 33 to 67% of the loss of wetlands during the 23 year study period could be a result of canals. A total of 58% of the variation in land loss among 140 quadrangle maps was explained by a multiple regression model that included canal densities at each time, relative age of the delta that formed the area, and the specific hydrologic regime of the area. By comparing the amount of land which had been lost due to the increase in canal area Deegan et al. (1982) concluded that up to 20% of the land loss could be accounted for as a direct conversion to canal area.

Another recent study that examined the effects of canals on land loss used a different approach, that of a simulation model of land change processes in the Barataria Basin (see below). This model incorporated the effects of canals on land loss in this basin (Cleveland et al. 1982), and the results of this study are illustrated in Figure 10.

MCPR. The change in wetland area in the Mississippi Chenier Plain Region has been documented from the years 1952-1974, as shown in Table 2. The major conclusion concerning overall habitat change from this study is that dur-

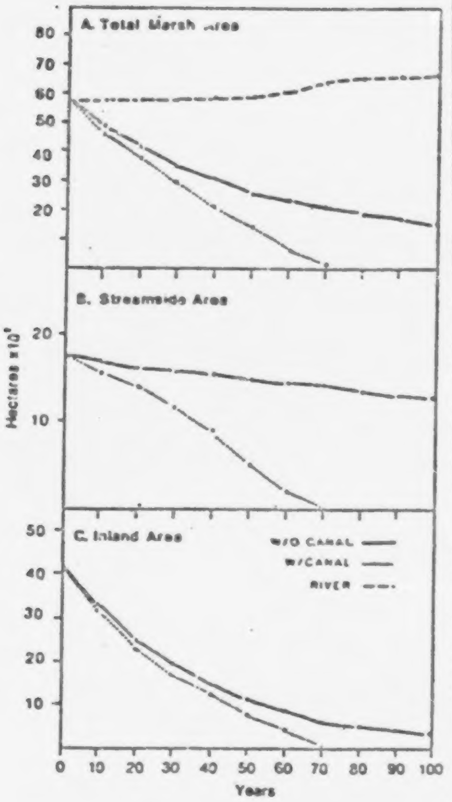

Figure 10. Results of simulation model for A) total marsh area, B) streamside marsh area, C) inland marsh area (from Cleveland et al. 1982).

ing the 22 year period for which comparable aerial imagery data were available, a total of 9.8% of the inland area in the MCPB has changed. Most of this change has involved the conversion of natural habitats to culturally modified habitats, such as pastureland, impounded marsh, urbanized areas, spoil banks, and rice fields. The trend has been for urban areas to displace agriculture, which in turn has encroached into natural wetland areas. Most of the wetland lost, however, has been converted into open water (26,280 ha). There was a 7.2% loss of natural marsh to open water from 1952-74. Part of this loss was attributed to the direct conversion of marsh to water via canal dredging, with additional losses secondarily induced by canals. For example, the Humble Canal system and the Superior Canal, both in the Rockefeller Wildlife Refuge in the Chenier Basin, were reported to be widening at rates of 7% and 13%/yr, respectively (Gosselink et al. 1979).

Burning has been blamed for marsh loss in some areas. Burning during dry periods may result in the killing of the roots of marsh plants and the oxidation of peat. The result may be a reduction in surface elevation and permanent inundation. Burning sometimes results from lightning, but more often it is intentional. In 1927 there was apparently a major marsh burn in the MCPB that resulted in the permanent loss of a large area of wetland, but unfortunately no documentation is available (R. Baumann, LSU Coastal Ecology Lab., personal comm.).

The probability that some of the recent wetland loss in the MCPR is due to natural causes, such as subsidence, and hurricane erosion, was discussed by Gosselink et al. (1979). The number of variables involved, and the complex geology of the area makes natural loss difficult to assess. For example, the artificial entrainment of the Mississippi River results in a continuous reduction in sediment supply to the MCPR. The fact is that until artificial hydrologic changes began there was a long term slow net gain of land (including wetland) in the area. This gain has been dramatically reversed, which implies that much of the loss is man-made, resulting from a combination of sediment starvation, canal construction related to oil and gas, salt water intrusion due to navigation channels and freshwater pumping for rice irrigation, marsh impoundment, cattle grazing, etc.

Aquaculture

There has been a dramatic increase in the culture of crawfish (Procambarus clarkii) in the study area since 1949, as shown in Table 3.

The life cycle of the crawfish is adapted to the seasonal cycle of flooding and draining that characterizes the natural swampforest habitat The increasing commercial

Table 3. Area Devoted to Crawfish Culture in Louisiana Over Time.

Year	Area (Hectares)	
1949	16	Gary 1974
1960	800	"
1966	2400	"
1968	4000	"
1969	4800	"
1970	7200	"
1971	9600	"
1973	17600	"
1976	18000	Fowler & la Bretonne 19
1978	19200	Fowler 1978
1980	22000+	Huner and Barr 1980

demand for crawfish, coupled with the realization that crawfish production can be artificially enhanced in leveed ponds with pumped water and planted browse crops, have led to a situation in which some additional forested wetland areas are being considered for clearing and leveeing specifically for crawfish production. For example, Franz (1974) predicted that crawfish production would ultimately occupy 80,000 ha of wetland in Louisiana alone.

Of the present area devoted to crawfish culture, which includes rice fields, leveed open ponds, and leveed swamp/marsh ponds, the latter accounts for about 44% of the total crawfish culture area in Louisiana (Huner 1979). One problem that is arising in this regard involves the difference in production betwwen swamp/marsh ponds and cleared ponds (300 lbs/acre to up to 4000 lbs/acre, respectively). Cleared ponds have been reported to produce crawfish annually at rates 10 or more times higher than in wooded ponds (Conner, pers. comm., Huner and Barr 1980). Part of this difference is thought to be due to the increase in sunlight that reaches the land/water surface after all trees are cleared. This sunlight stimulates the growth of non-woody plants that serve directly as food for crawfish.

The production difference should be examined closely, however, because it is partially the result of other variables, such as the fact that wooded ponds tend to be larger than cleared ponds. There is an inverse relationship between pond size and crawfish production, partly because small ponds have relatively more levee (elevated) areas on which crawfish depend for climbing above the water surface. In addition, fish predators can be more easily eliminated from small ponds than from wooded ponds. Such fish as the bowfin (Amia calva) are routinely poisoned in crawfish ponds. On the other hand, the water in cleared ponds is warmer and more subject to anerobic conditions, which necessitates more pumping. Finally, little data exist on nutrient cycling and other ecosystem processes in cleared ponds. Most of the ecosystem value of forested wetlands is lost when forested wetlands are cleared for crawfish production exclusively.

A new system of crawfish production and silviculture is now being attempted for the first time in the study area. Certain leveed wetland areas that are dominated by medium trees as willows are being cleared and replanted with cypress seedlings. This is being done on an experimental

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basis by the St. Martin Land Company, Inc., William Trimble, manager. While the trees are growing the areas will be pumped to simulate the natural hydrologic cycle, and intensive crawfish production will be practiced (including predator control). Planted areas will be maintained in a thirty year cycle of tree growth, followed by cutting and replanting if the effort goes as planned. This system is experimental and it will include the long term monitoring of tree growth, crawfish production, and other parameters.

It should be noted that an additional difference in reported crawfish production between cleared and wooded ponds may be the result of under-reporting of crawfish harvested in large wooded ponds for tax purposes, a practice that is not uncommon among crawfish producers, oystermen, and other fishermen. Large ponds are more difficult for a landowner to monitor. The St. Martin Land Company charges $10/acre to lease a wooded pond for crawfishing and $270/acre for a cleared pond.

The Louisiana Coastal Management Section reports only six coastal use permit applications for crawfish culture efforts (most, no problem) during the nearly two year period of the program's operation. Five of these were for crawfish ponds on agricultural land and were determined to be exempt from state coastal use permitting requirements. They do anticipate an increase in the number of applications over the next few years. In the only problem application, still pending at this time, the applicant wanted to clearcut a cypress swamp area to increase crawfish productivity (see above). La. C.M.S. has two concerns about the application: (1) whether it meets the "normal forestry or agricultural" coastal use permit exemption and (2) whether the impact of the activity on hydrology would comply with the state's coastal use guidelines.

It is not clear that crawfish ponds will continue to expand as in the past. Some argue that it is leveling off while others project rapid expansion. Major future expansion of this enterprise will undoubtedly depend on the rate of increase in energy costs.

In summary, the natural value of forested wetlands is largely lost when these areas are cleared for crawfish production, and an entrepeneur may end up paying in energy terms (pumping, planting, etc.) for any increase in crawfish production that accompanies clearing.

Wetland Loss in the Barataria Basin of Louisiana

Much of our understanding of wetland loss in the MDPR (conversion of wetland to open water) has been gained through intensive study of the Barataria Basin, one of seven basins in the region (e.g., Adams et al. 1976; Craig et al. 1979; Turner 1981). The major conclusions of these studies are the following: (1) The most rapid loss is in the brackish marshes (Table 4), (2) Land loss is apparently related to canal density, and (3) The rate of land loss is accelerating.

Table 4. Land loss in Barataria Basin (from Craig et al. 1979)

	Gagliano & van Beek (1970) 1890-1960 (ha/yr)	Adams et al. (1976) 1960-1974 (ha/yr)*
Salt marsh	337	394 - 519
Brackish marsh	371	535 - 1,593
Fresh marsh	77	361 - 566
Total Marsh	785	1,290 - 2,679

*Highest and lowest annual values found at a number of test sites

Adams et al. (1976) studied land changes for a number of sites in the Barataria Basin; a positive relationship was found between canal density and land loss (Table 5).

Land loss in the Barataria basin is accelerating, as indicated by a comparison of rates from 1890-1960 and 1960-1974. This trend of accelerating land loss has recently been documented for the MDPR (Gagliano et al. 1981). The area occupied by canals in the Barataria Basin also seems to be increasing (Table 6).

Table 5. The relationship of land loss in the Barataria Basin (% marsh per year) and human activities as estimated by canal density (% total marsh) area.

Activity	n	Range	Canal Density (a) Mean (S.D.)	Land Loss (b) Mean (S.D)
Light	3	0 >1	.34 (.35)	.007 (.024)
Light-Moderate	2	>1 <2	1.31 (.11)	.093 (.071)
Moderate	1	>2 <3	2.0 (-)	.084 (-)
Heavy	1	>3	2.81 (-)	.105 (-)

Equation of best fit: Land loss = .074 + .01(canal density); R2= 0.69 (a) Chabreck et al. (1966), (b) Adams et al. (1976)

Table 6. Summary of inventory results of land loss for the Barataria Basin.

Area	% Canal/ Marsh Area	Methodology	Reference
Barataria Basin (2,427 sq mi.)	2.6	Photomosaic	Adams et al. (1976)
Barataria Basin (2,025 sq mi.)	1.1	Points counted by helicopter from pre-selected transects	Chabreck (1972)
Barataria Basin (Gulf to Intracoastal Waterway, 1,370.5 sq mi.)	1.0	Map measurement with various dates and scales	Barrett (1970)

Impoundments. Beginning in the late 1800's and continuing until the 1970's, impoundments have been created for agriculture or urban development in fresh and brackish marshes in the Barataria Basin. Impoundments include "dry land," impounded marsh, and open marsh; and they may be completely enclosed, or connected with nearby waterbodies. There are numerous wetland sites within the Barataria Basin that are partially or totally impounded, and cut off from normal movement of water, dissolved and suspended matter, and organisms. Many of these sites were created accidentally as a result of cumulative effects of projects in the wetlands (e.g., contruction of spoil levees) that impede water flow.

An example of accidental impoundment is an area of swamp west of Lac des Allemands that has been almost completely impounded by road embankments, and by the spoil bank from dredging Bayou Chevreuil. This area has been studied over the past decade (e.g., Conner et al. 1981, Hopkinson and Day 1980). Various studies have shown that the impounded area does not dry out as natural swamp does; it has much lower water turnover, and lower primary and secondary productivity; and its wildlife habitat value is decreased, e.g., virtually no fish are found in the stagnant water in the area.

Many of the impounded areas in the Barataria Basin were originally constructed as a means of floating out timber. Some of these areas have been enlarged, and new impoundments have been created by the placement of dredged spoil material from channelization, road construction, and canals constructed for pipelines, drainage, and petroleum access.

Former wetland areas that have been impounded, and that are maintained as dry land for residential purposes, etc., are completely or partially below sea level. The elevation is lowered because of the compaction of soils and the oxidation of peats after the land was pumped dry. Because of the high costs of keeping such land dry, many such sites have been abandoned and now are open water ponds, being too low to support emergent vegetation. Other areas of marsh have been diked but have not been continuously pumped, and are still marshes. In addition to these sites, there are a number of areas adjacent to the natural levees of the Mississippi River and Bayou Lafourche that have been impounded in order to extend the natural levee.

An undetermined area of marsh land has been unintentionally impounded by the construction of canals. The topography and hydrology of the marsh have been most altered in the vicinity of dense canal networks associated with major oilfields such as Venice, Leeville, and Lafitte. Long canals can result in the impoundment of large areas of marsh as well as being salt water corridors.

Hydrological Changes. Hydrology in the Barataria Basin has been altered in three ways: (1) Upland runoff enters waterbodies rapidly and directly via canals, bypassing wetlands that would otherwise receive it. (2) Water exchange between different parts of the basin is speeded up because of the construction of new canals or the deepening of natural channels. This is especially true for the mid Barataria Basin. (3) Water flow over wetlands is inhibited because of spoil placement. This decreases the deposition of suspended sediments and exacerbates the existing sediment deficit in inland marshes. Because sedimentation is the single most important source of "new" nutrients to the marshes (DeLaune and Patrick 1980), a lack of sediments leads to lower marsh productivity.

IV. HISTORICAL USE OF WETLANDS IN THE STUDY AREA

In this short section, a broad view of the general reasons for the present situation of rapid wetland loss in the study area is presented. This synopsis is largely the opinion of the author, based on a limited understanding of the cultural history of the study area.

The overall reason for the historical cultural decimation of wetlands in all three regions affected by the lower Mississippi River is directly or indirectly related to the general undervaluing by society of wetland habitat. It is hardly surprising that during the middle of the last century wetlands were viewed as wastelands. It is clear that a pejorative view of marshes and swamps existed then (this view still persists in some quarters today). Wetlands were viewed as not only worthless, but as an impediment to progress. The Swampland Acts of 1849,1850 and 1860 ceded to the states all lands then unfit for cultivation due to flooding (Gosselink et al. 1981). The Swampland Acts were passed for mosquito control, to "reclaim" lands for agriculture, and to enhance the value of adjacent federal land, but they resulted ultimately in the acquisition of very large tracts of land for very little money by individuals, corporations, and local governments.

The following quotation is from a book on Louisiana's physical and cultural geography by Kniffen (1968).

"As late as 1819 a government survey found the stands of cypress virtually untouched. In 1849 the swamplands were transferred from the federal government to the state of Louisiana. A survey made in 1833 showed that some of the cypress had been stolen, but not much. In 1876 the Timber Act opened the cypress lands for sale. By 1880 outside investors and lumbermen were buying the cypress lands for from twenty-five to fifty cents an acre!"

Small local lumber mills were replaced around 1890 with industrial scale operations, and the peak in lumbering occurred between 1910 and 1914, when Louisiana led the nation in lumber production. By 1925 the boom was over and millions of denuded acres of former swamp forest were left behind (Kniffen 1968). Thus, in only thirty-five years, these forests, particularly those in the Atchafalaya Basin, were depleted of all first growth timber.

Most of the lumber removed from the MRAV before and after the turn of the century was sold to satisfy a strong demand for building materials in the northeast and eastern south. Large numbers of Victorian cypress houses are still extant in southern cities, such as New Orleans, Charleston, and Savannah, attesting to the exceptional characteristics of old growth cypress.

Regrowth cypress is only now beginning to be harvested on a small scale in the Barataria Basin (Conner, pers. comm.). The retail cost of regrowth cypress lumber is considerably greater than some other woods, despite the fact that regrowth (new) cypress is not especially rot resistent compared to other types of lumber. This suggests that a market could exist for bottomland forest species grown on managed plantations within the MRAV, that could compete with soybeans. On the other hand, the stumpage price of cypress, sycamore, and other wetland timber from the MRAV was reported at about half the cost of pine (MacDonald et al. 1979). The reasons for this anomaly are not mentioned in the latter study. Another interesting observation is that the estimated value of timber is based only on board feet and does not ordinarily reflect the marked difference between mature trees and young (30 year) trees that are managed for maximal wood production per unit time.

The initial rush to reclaim wetlands was followed by the discovery in many areas that the hydric soils were unfit for agriculture, in the days before soybeans were "discovered." Many early clearing projects were thus abandoned, and bottomland hardwood habitat showed a temporary increase in some areas because of regrowth between 1940 and 1960. This was true in some portions of the MRAV, but not for the whole region, however (MacDonald et al. 1979).

The Swampland Acts included the provision that the federal government would assist in public works, land reclamation, and drainage projects, as incentive to prospective buyers. This traditional support continues today, primarily through the COE and Soil Conservation Service small watershed program (Turner et al. 1981). Thus, it was somewhat ironic that the COE was given regulatory powers over wetlands through Section 404 of the Clean Water Act of 1972 (see Task 2). Wetlands in the study area are decreasing, but the percentage of bottomland hardwood forest defined as wetland, and requiring a COE permit before clearing, has increased because of a federal decision related to the definition of wetlands in Avoyelles Parish, Louisiana (see Task 2). Nevertheless, this historic decision to include bottomland hardwoods under regulated wetlands is being applied by the COE only in the federal court district in which the decision was made.

The recognition that wetlands perform a variety of extremely valuable services for society is a recent phenomenon. Much of the evidence has, until recently, either been qualitative, or of the nature of statistical associations without proven causality. There are still many skeptics who, like diehard smokers with reduced lung capacity, await the ultimate proof of the harm in further loss. Meanwhile, wetland losses continue to accelerate, with relatively little sign of alarm on the part of the public. This is particularly true in Louisiana, a state with much of the remaining wetlands to lose. Some state officials in Louisiana, including Governor Treen, recently promoted a plan to purchase large swamp forest tracts in the Atchafalaya Basin for preservation, recreation, and flood control, but the necessary money has not been raised at this time.

Oil production in Louisiana began in 1902, and had totaled 38 billion barrels by 1936, with no end in sight at that time according to Kniffen (1972). Until recently, the most productive onshore fields have for the most part underlain MDPR wetlands. Thus the mineral rights to former state-owned wetlands that had largely been acquired for very little money by a few individuals and corporations, became extremely valuable. No wetland regulations existed to discourage wetland destruction, and the direct market value of the petroleum, then as now, far overshadows the market value of wetlands.

Summary. Cultural impacts on wetlands in the study area can be classified into five categories: (1) agriculture, (2) timber harvest, (3) oil and gas production, (4) navigation and flood control, and (5) population growth and urban expansion. Within the MRAV, categories (1) and (4) have played major roles in the observed wetland loss. Within the MCPR (1), (3), and (4) are the major factors. The MDPR is the most complex of these three regions, and all five factors have played important roles. The sequence of events that led to the present situation probably begins with (2) and (4), with flood control (river entrainment) being most important. The next major change was the discovery of oil and gas in the wetland zone, with the attendant effects of production activities. Finally, and largely as a result of the oil and gas production, an industrial complex

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and population shift occurred that led to secondary developmental pressures on wetlands.

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TASK 2

LEGAL/INSTITUTIONAL FACTORS AFFECTING WETLAND TRENDS AND USE IN THE STUDY AREA: LOUISIANA, MISSISSIPPI, AND TEXAS*

by

M. W. Wascom

This paper surveys legal/institutional factors affecting wetland trends in the relevant wetland areas of Louisiana, Mississippi, and Texas. These relevant wetland areas are primarily the coastal wetland areas of the three states, and additionally, the forested wetland acreage located in the New Orleans and the Vicksburg Districts of the Corps of Engineers.

CORPS DISTRICT

Four Corps of Engineers (COE) Districts cover the survey area. The Mobile District has jurisdiction over Mississippi's coastal area, including the area subject to Mississippi's coastal zone

*This paper is based in part on a series of telephone and direct interviews with government officials and individuals from Louisiana, Mississippi, and Texas, comments received from those who reviewed two earlier drafts, and from the June 24th, 1982, workshop held in Baton Rouge. Federal and state resource and regulatory agency officials and representatives of the oil and gas industry, agriculture, forestry, and an environmental group were in attendance at the workshop. The numbers accompanying the following text refer to citations, which are appended at the end of the paper.

program, with the exception of the Pearl River Basin, which was recently transferred to the Vicksburg District's jurisdiction.

The Vicksburg District has jurisdiction over a portion of southeast Louisiana, including the Pearl River Basin and a portion of the area encompassed by the Louisiana coastal management program, and is otherwise included in this report because its jurisdiction also includes a major portion of the forested wetland acreage located in the study area. The New Orleans District includes most of the area encompassed in the Louisiana coastal zone management program, most of the southern portion of the state, and most of the northwest part. Part of its jurisdictional area will be transferred to the Vicksburg District by the end of the year. The New Orleans District will then be, generally, the central part of the state south. In addition to the Texas coastal area from the Louisiana border to that with Mexico, the Galveston COE District also includes a small portion of southwest Louisiana to the easternmost extent of the Sabine River floodplain. (Note: Texas does not have a state coastal zone management program) (1).

CORPS WETLANDS PERMITTING

Although the authority of the COE to issue permits for the discharge of dredged or fill material into the waters of the U.S. (including wetlands) (2) under Section 404 of the

Federal Water Pollution Control Act (3) is the primary concern of this segment of my report, in the New Orleans, Galveston, and Mobile Districts, both a Section 404 permit and a permit under Section 10 of the Rivers and Harbors Act (4) for any project affecting the course, condition, or capacity of navigable waters are required for many projects. This is primarily true in the case of oil and gas related projects e.g., those that involve obtaining access to a wetlands area from a navigable waterbody. Of the three coastal COE Districts, the New Orleans District has the highest permit application volume, averaging in the range of 2,500 - 3,500 total Section 404 and Section 10 permit applications a year. Of these about 40% are Section 404 permit applications, one out of five of which is directly related to oil and gas activities and 60% are directly or indirectly related to this activity. (5)

The Galveston District has the next heaviest load with 2,000 total Section 404 and Section 10 permit applications a year. Sixty percent of these applications are combined Section 404 and Section 10 applications (application for both made at one time). The majority of Section 404 permits are oil and gas related as is a significant percentage of Section 10 applications, with the second largest category being applications to fill in waterfront lots. (6)

There is currently very little oil and gas activity in coastal Mississippi but this is expected to change since the state held its first oil and gas lease sale for offshore tracts in July. Consequently, with respect to Section 404 permit applications for activities in the Mississippi coastal area, the majority of these applications currently handled by the Mobile District involve port-related activities. The state lease sale will likely result in an increase of Section 404 (and Section 10) activity handled by the Mobile District. (7)

In the Vicksburg and New Orleans Districts, a very important type of activity has been regulated since 1979 in the portions of these Districts included in the U.S. Western Judicial District of Louisisana. In the case of Avoyelles Sportsmen's League v. Alexander, (also known as the Prevot Case) actually two cases (8), a Federal District Court, based on the facts involved, determined that a land-clearing operation involving the conversion of forested wetlands acreage, i.e,. a 20,000 acre bottomland hardwood forest tract to agricultural use was an activity requiring a Section 404 permit and was not an exempted agrigultural activity under Section 404(f)(1)(a) which exempts "normal farming silvicuture and ranching activities" from Section 404 permitting nor Section 404(f)(2) which provides that regardless of whether an activity would normally be exempt from Section 404 permitting, if the discharge of the dredged or fill material is incidental to an activity designed to bring an area of water of the U.S. "into a use to which it was not previously subject where the flow or circulation of navigable waters (waters of the U.S.) may be impaired or the reach of such waters be reduced" a Section 404 permit is required (9). The case is currently on appeal in the U.S. Fifth Court of Appeal in New Orleans, which is the federal appeal court for Louisiana, Mississippi, and Texas. (Note: a similar fact-pattern case, arising in northen Mississippi, is currently being argued in a Mississippi federal district court). (10)

At the Washington-level of the COE, it was decided that the COE would adhere to the holding of the case only in those portions of COE Districts that are also in the U.S. Western District of Louisiana, i.e., in portions of the Vicksburg COE District and the New Orleans COE District. The COE rationale for this position is that the judge's decision in the case was not a broad based decision attacking the validity of COE Section 404 regulations (as has been the case in other federal district court decisions recognized nationally by the COE) but that the Avoyelles Sportmen's League case was an action to compel the COE to regulate (under Section 404) the specific activities occurring on the specific tract involved. Also part of the rationale is the idea that, in a similar fact situation, a different federal judge in a different Federal Judicial

District might decide differently. (11) The legal validity of this COE rationale for its restrictive application of the Avoyelles Sportsmen's League case is highly debatable.

The Avoyelles Sportsmen's League case initially met with a hostile reception from agricultural and forestry interests in the area affected by the decision. (12) Subsequent to the decision, a permit application of February 1981 to the Vicksburg COE District involving the clearing of the last remaining forested wetlands in East Carroll, Parish, Louisiana, became a "cause celebre" both for those who opposed and those who supported the holding in Avoyelles Sportmen's League. To date, no decision has been made in the Section 404 permit application by the Westbank Planting Company, and in accordance with upper-level permit review procedures then in operation that were established pursuant to Section 404 and the federal Fish and Wildlife Coordination Act, (see below), the permit application is currently being reviewed by the Assistant Secretary of the Army for Civil Works (13).

Although the forestry industry, and in the affected area that is part of the Vicksburg District, agricultural interests have apparently generally come to accept the holding with some hesitation, agricultural interests living in the New Orleans District area definitely have not. (14) It goes without saying that, if applied nationally, the

Avoyelles Sportsmen's League case would enliven an already animated debate over the extent of Section 404 regulatory jurisdiction. The decision in the case and the COE decision to limit the area in which it will adhere to the decision are matters that merit national attention and debate. The recent mandate on Section 404 (and Section 10) reform by the Vice-President's Task Force on Regulatory Relief requiring the COE and the U.S. Environmental Protection Agency (EPA), in consultation with other expert agencies, to develop new and more specific criteria redefining the jurisdictional scope of the Sec. 404 program and specifying which type of wetlands are and are not appropriately covered by the Clean Water Act will no doubt stimulate that national attention and debate. (15)

INTERAGENCY COOPERATION ON SECTION 404 PERMITS

The Federal Water Pollution Control Act gives much oversight authority relative to Section 404 permitting to the U.S. Environmental Protection Agency (EPA) in the form of responsibility for the development and promulgation of guidelines pursuant to Section 404(b)(1) that are to be applied by the COE in specifying a disposal site for each Sec. 404 permit; (16) authority to prohibit the specification of any defined area as a disposal site; if, among other things, the discharge would have an adverse impact on shellfish beds, fishing areas, or wildlife under Section

404(b)(2); (17) authority to determine the reach of the term "navigable waters," i.e., "waters of the U.S.," for purpose of Section 404 jurisdiction; (18) and final authority to determine whether an activity that the COE determines would come under Section 404 requirements is exempted from Sec. 404 permit requirements under Section 404 (f). (19) Although these powers and the authority given in Section 404 (q) include the authority to review each Sec. 404 permit application, and comment on the water quality aspects of the proposed activity in the three state area, EPA is actively involved in case by case permit review only in the Vicksburg District. (20). It is felt that this lack of case by case involvement is a result of a feeling by EPA officials that, with EPA's other extensive regulatory responsibilities, they don't have much time to devote to reviewing Sec. 404 permit applications. (21)

EPA's review of Section 404 permit application is governed pursuant to a memorandum of agreement (MOA) with the COE pursuant to Section 404(q) of the Clean Water Act. A new Memorandum of Agreement, pursuant to administrative reforms mandated by the Vice-President's Task Force on Regulatory Relief (see note 15 above) was signed by the COE and EPA on July 2, 1982. This memorandum governs the same permit matters that are governed in new MOA's between the COE and the U.S. Dept. of the Interior (U.S. Fish and Wildlife Service) and the U.S. Dept. of Commerce (National Marine Fisheries Service) (see below). (22)

EPA's greatest impact on Section 404 permitting authority is through its Section 404 (b)(1) guidelines (23) and its authority to determine the reach of the "waters of the U.S." which are subject to Section 404 permitting. The basic policy of EPA's 404 (b)(1) disposal site guidelines is that "dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact individually or in combination with known and/or probable impacts of other activities affecting the ecosystem of concern... the degradation or destruction of special aquatic sites, such as filling operations in wetlands, is considered to be among the most severe environmental impacts covered by these Guidelines. The guiding principle should be that degradation or destruction of special sites may represent an irreversible loss of valuable aquatic resources." (24) The guidelines detail potential impacts of dredged and fill deposition on the aquatic ecosystem and delineate actions that can be taken to minimize adverse effects of such deposition. (25) It was pointed out that the New Orleans COE District has difficulty applying the Section 404 (b)(1) guidelines to Avoyelles Sportmen's League - type agricultural conversions, particularly the guideline which provides: "Except as provided under Section 404 (b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." (26). This is a problem area that should be resolved by the COE and EPA.

Pursuant to a Memorandum of Understanding published on July 2, 1980, (27) and a listing of special cases published Oct. 24, 1980, (28) EPA and the COE have agreed to a procedure for resolving geographical problems involving the jurisdictional reach of the Sec. 404 permit program (i.e., for determining when an area is a "wetland" subject to the Sec. 404 permit program) arising under Sec. 404. For the three state study area, the salient point of all this is that although the COE makes the great majority of Sec. 404 jurisdictional decisions, EPA and the COE have set forth "special cases" which, which, when discovered in the course of prepermit inquiries or in permit applications to the COE, will automatically be referred to EPA for a Sec. 404 jurisdictional determination (i.e., a determination as to whether the "special case" involved is a wetland area subject to the Sec. 404 permit program). The "special cases" listing of October 24, 1980 primarily deals with bottomland hardwood areas in specific parishes of Louisiana and specific counties of Mississippi and Texas which contain one or more of the following Society of American Foresters forest cover types: river birch-sycamore, type 61; silver maple-American

elm, type 62; cottonwood, type 63; pin oak-sweetgum, type 65; laurel oak-willow oak, type 88; sweetgum-American elm-green ash, type 93; sycamore-pecan-American elm, type 94; beech-magnolia, type 90; loblolly pine-hardwood, type 82; slash pine-hardwood, type 85; and swamp chestnut oak-cherry-bark oak, type 91. (29)

Administrative reforms mandated by the Vice-President's Task Force On Regulatory Relief included clarification of the jurisdictional scope of the Section 404 permit program (including a clarification as to what types of wetlands should be covered by the Sec. 404 permit program) and the use of more state general Section 404 permits by the COE. The manner in which these are eventually implemented could well cause major changes in the manner by which Sec. 404 jurisdictional issues are currently handled by the COE and EPA.

In the three state study area, the primary interagency consultations on and reviews of Section 404 permits occur pursuant to the Section 404 (q) of the Clean Water Act and the federal Fish and Wildlife Coordination Act, (31) (FWCA) and in Louisiana and Mississippi, pursuant, additionally, to the consistency provision of the federal Coastal Zone Management Act (CZMA). (32) Section 404(q) requires that MOA's between the appropriate agencies (EPA, FWS, NMFS) and the COE assure that, to the maximum extent practicable, a COE Section 404 permit decision will be made not later than

90 days after the COE issues its public notice. The FWCA requires the COE, in processing Section 404 (and Section 10) permit applications to consult with federal and state fish and wildlife agencies in order to determine what measures might be necessary to mitigate and compensate for losses of "wildlife resources" (e.g., birds, fish and mammals, and their habitat) that would occur as a result of the activity proposed in the permit applications, as well as enhance those resources. (33) The FWCA also requires the COE (and other federal agencies) to give full consideration to the recommendations of these wildlife agencies and to incorporate in its permit decisions those reccommendations that it finds justifiable to obtain maximum overall project benefits. Under the FWCA, these agencies act as advisory agencies to the regulatory agency.

In the three state study area, the FWCA agencies with which the COE must consult are the U.S. Fish and Wilife Service (FWS) (fish and wildlife resources habitat) the National Marine Fisheries Service (NMFS) (habitat supporting marine resources), the Texas Parks and Wildlife Department, the Louisiana Department of Willife and Fisheries, and the Mississippi Department of Wildlife Conservation. The FWCA process between the COE and the federal agencies is coordinated pursuant to memoranda of agreement (MOA) between the agencies, the most recent being signed on July 2, 1982 in response to a mandate from the

Vice President's Task Force on Regulatory Relief. As with preexisting MOA's, the new MOA's between the agencies governs the administrative arrangements for handling permit review pursuant to the FWCA (and for Section 404, pursuant also to Section 404(q)) on Section 404 (and Section 10) permits and for handling permit disputes between a COE District and FWS and/or NMFS. (35) Pursuant to the Vice-President's Task Force mandates, the new MOA's call for a shorter Section 404 permit decision time and refining and clarifying the procedures and criteria for elevating interagency disputes on Sec. 404 permit decisions above the COE District Engineer level. These Task Force reforms anticipate final Sec. 404 permit decisions being made by the District Engineer in the vast majority of cases. (36)

Agency officials contacted prior to the signing of the new MOA's in the three state study area seemed to feel that FWCA process with respect to Section 404 (and Section 10 permitting, including the dispute settlement arrangement) worked fairly well, with its major accomplishment being the modification of proposed Section 404 project plans based on fish and wildlife agency comments. It should be pointed out that, in the "special case" situations discussed earlier, the FWCA does not come into play for Section 404 purposes, unless and until EPA makes a jurisdictional "call" that the special case area involved is subject to the Sec. 404 permit program. Currently, EPA is exercising this Sec. 404 jurisdictional "call" authority primarily in the Louisiana portion of EPA Region VI that is also within the Vicksburg COE District. (37) As an example of this "smooth" working relationship under the FWCA, it was pointed out that, in the two years from March 1980 - March 1982, in the New Orleans COE District only 20 disputes over a fish and wildlife agency's recommendation for permit denial had to be resolved. Of these, 9 were resolved at the Vicksburg Division level and 4 were resolved at the level of the Office of the Chief of Engineers. 18 of the 20 permits were ultimately issued, after generally being altered to accommodate wildlife agency concerns. (38)

With respect to the EPA-COE consultative process in the study area, there is a feeling that the jurisdictional determination issue is still a source of controversy and disagreement between the agencies, particularly since these determinations must so often be made on a case-by-case basis. There is also a feeling by the COE that EPA often will make a jurisdictional "call" in "special case" situations in favor of Section 404 jurisdiction on a proposed activity, thereby invoking the FWCA process, and often will make no objection to issuance of a Section 404 permit for the activity based on water quality criteria. This is seen by the COE as a problem with the consultative process required by Section 404. EPA's position is that, in cases where it makes a jurisdictional "call," it will usually comment to the COE on the Sec. 404 permit application from a water quality standpoint. There are times that, although EPA cannot mandate that certain conditions be incorporated into a Sec. 404 permit, it will recommend to the COE that the permit not be issued without the incorporation of these conditions into the permit. EPA sees its jurisdictional calls as not being made just for water quality comment purposes, but also for the purpose of opening up public comment on proposed Sec. 404 activities in "special case" areas. (39)

There is a lack of understanding on the part of the public in the 3 states as to the Section 404 EPA-COE consultative process and as to the FWCA process, particularly in the sense of predictability of: (1) Sec. 404 wetland jurisdictional "calls" by EPA, and (2) conditions imposed on Section 404 permit applications to lessen the impact of the activity on wetland habitat or offset adverse impacts of the activity on wetland habitat. A significant part of the public does not understand nor like the delays in obtaining a Sec. 404 permit decision when the agencies involved in the Sec. 404 EPA-COE consultative process and the FWCA process disagree as to whether such conditions should be included in a Sec. 404 permit for the proposed activity and/or whether a Sec. 404 permit should be issued for the particular activity propoed to be conducted. Farmers and timber company officials, in particular, object to what what they consider unpredictability in wetland jurisdictional determinations made under Section 404. The agencies involved in the Sec. 404-FWCA permit consultation process point out that the delay in obtaining a Sec. 404 permit decision is quite often the fault of the Sec. 404 permit applicant in not responding to overtures by an agency to the applicant to discuss the proposed activity and possible conditions on the carrying out of the proposed activity that the agency might wish to see included in the Sec. 404 permit for the activity. (40) Although FWS has published its overall mitigation policy, and its guidelines with respect to oil and gas activities in wetland areas, and although NMFS has set forth its mitigation policy in numerous public hearings, concern with predictability of conditions and frustration with the mechanics of the FWCA consultative process, particularly the delays it causes in getting a Section 404 permit decision, are particularly evident in the oil and gas industry. (41) (An analysis of oil and gas industry concerns with the FWCA-Section 404 review process was the subject of a Congressional hearing in New Orleans in October, 1979). The supposed "extreme" delays in permit issuance caused by the FWCA process have effectively been shown by FWS, NMFS, and the New Orleans COE District to be minimal, but this industry viewpoint has persisted. (42) Partly because of these concerns the industry listed Section 404 as number two on the list of programs needing regulatory reform that it submitted to the Vice-President's Task Force. (43) This concern with predictability of conditions is not limited to the oil and gas industry, however, but is shared by many groups.

As a response to such concerns, the Vice-President's Task Force directed the COE, EPA, FWS, and NMFS to sign new MOA's governing their Section 404 consultative review processes, and the elevation of inter-agency Section 404 permit issuance disputes beyond the district engineer level. As noted above, these new MOA's were signed on July 2, 1982. The Task Force also directed the issuance of more COE general permits on a statewide basis and called on EPA and the COE to clarify Section 404 jurisdictional criteria. (44)

The Task Force reforms do not specifically deal with the related problem of the apparent feeling on the part of the public that there is unpredictability as to conditions imposed on Section 404 permits because of the FWCA process. One innovative approach to the predictability of conditions problem associated with FWCA was started by the Texas General Land Office in 1971 with the goal of aiding oil and gas lessees of coastal and submerged lands under its jurisdiction in obtaining the requisite federal and state approvals and/or permits in the most expedient manner possible. The General Land Office polled federal agencies on what conditions and environmental recommendations they wish to see put on activities in waters of the U.S. / Each tract offered for lease sale by the General Land Office has conditions and recommendations assigned to it based on what the state has been told are concerns of federal and state regulatory agencies. This listing of conditions is currently being revised. The state warns lessees that, as experienced previously, if these concerns are not satisfied by the project's plans, any one of the state or federal regulatory agencies can halt or delay the issuance of a permit. As published by the General Land Office, these recommendations have a broader influence by affecting the planning for activities over and above those associated with oil and gas development on state coastal and submerged lands. This General Land Office practice also has an impact on OCS oil and gas activities, since most of this OCS oil and gas must begin in or pass through state-owned coastal and submerged land tracts. (45) It should be pointed out that FWS and NMFS maintain that there is a great deal of predictability as to the conditions imposed on Section 404 permits in a particular area, especially among industry permit applicants. Whether real or imagined, this is a problem area, however, that needs to be focused on by FWS, NMFS, and the COE at the national level.

Pursuant to Section 307 of the federal Coastal Zone Management Act, (46) an applicant for a Section 404 (or Section 10) permit for an activity affecting land or water uses in the coastal zone of a state having a federally approved coastal management program, must include a certification in his COE permit application that the proposed activity will be complied with and will be carried out consistently with the state's coastal program. A copy of this certification must be furnished to the state coastal agency, which is required to notify the COE whether or not it concurs with the permit applicant's certification. If the state does not concur, i.e., it finds that the activity is not consistent with its coastal program, the COE cannot issue the Section 404 permit. In the study area, the three relevant COE Districts cannot issue a Section 404 (or Section 10) permit until and unless the Louisiana or Mississippi coastal agency concurs with an applicant's consistency certification. If the activity is also one that would require a coastal management permit under the state's program, none of the Districts will issue a Section 404 (or Section 10) permit unless and until the state agency issues a state coastal management permit. In other words failure to issue a state coastal management permit constitutes a "negative consistency" determination. (47)

STATE WETLAND PERMITTING PROGRAMS

A. Texas

As noted earlier, (48) Texas does not have a federally approved coastal management program, having withdrawn from the federal approval process in May, 1981. The state has no foreseeable plans to devlop a federally approved plan. (49)

While there is no state regulatory program addressing Section 404 type dredge and fill activities occurring on private land, pursuant to the Coastal Public Lands Management Act of 1973 and the regulations adopted pursuant to it the state administers a limited permit program of this type in the state-owned bays, estuaries, wetland, and submerged lands. The Act provides for regulation by the School Land Board of the General Land Office of the construction, placement, and use of all "structures" (e.g. land canals, channels, excavations) which extend onto the state-owned coastal public lands. Under the Act, channel dredging and spoil disposal in these state owned areas require a lease or easement from the School Land Board. (50)

B. Mississippi

The regulation of dredge and fill activities in the coastal zone of Mississippi (Figure 1) is accomplished by the Mississippi Coastal Program, federally approved in September, 1980, primarily through the Coastal Wetlands Protection Law (51) which is the heart of the Mississippi Coastal Program.

The law applies to the management and use of coastal resources in the three Mississippi coastal counties and all adjacent coastal waters found within the 3 mile territorial sea limit and the barrier islands along the coast. The term "coastal wetlands" is defined to include the flora and fauna on the wetlands and in the wetlands. (52)

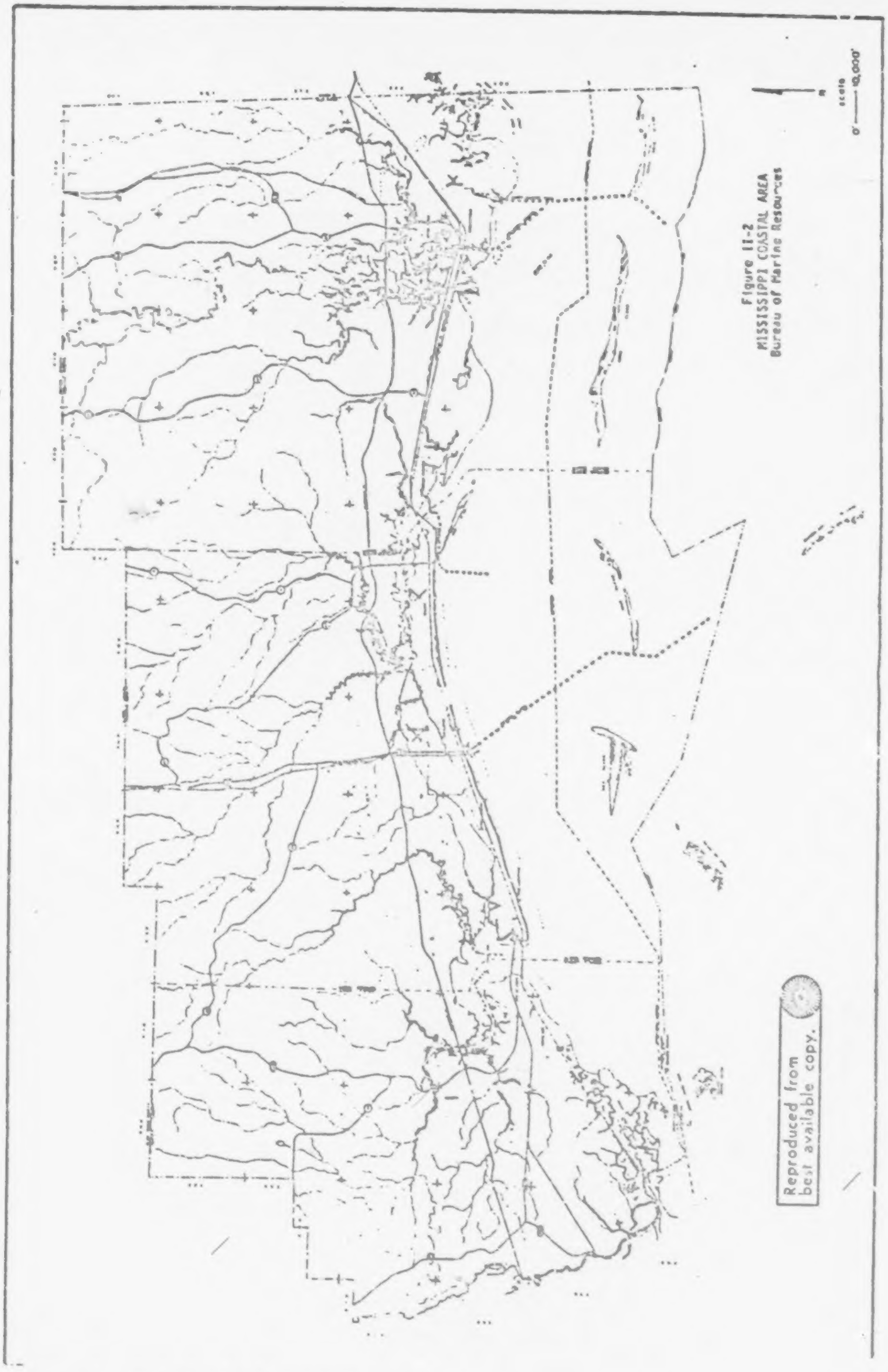
Figure II-2
MISSISSIPPI COASTAL AREA
Bureau of Marine Resources
N
scale
0'——10,000'

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Figure 1. Mississippi coastal zone.

Three general types of activities are subject to the permit requirements of the Wetlands law: (1) activities actually conducted in the coastal wetlands; (2) activities occuring outside the coastal wetlands which affect the coastal wetlands; and (3) the erection of structures on sites suitable for water dependent industry. Dredge and fill activities are specifically defined as "regulated activities" under the Wetlands Law. The law exempts certain activities from the wetlands permitting process, e.g., hunting, fishing, and shellfishing; the exercise of riparian rights by the owner of those rights; an activity conducted by a water dependent industry; several port commissions; and state-permitted oil and gas activities. (53) However, any person or agency conducting an exempt activity is required to conduct the activity in a manner that is CONSISTENT (emphasis added) with the public policy of the wetlands law, which is:

"to favor the preservation of the natural state of the coastal wetlands and their ecosystems and to prevent the despoilation and destruction of them, except where a specific alteration of specific coastal wetlands would serve a higher public interest in compliance with the public purposer of the public trust in which wetlands are held." (54)

Coastal wetlands permits are issued by the Bureau of Marine Resources (BMR) of the Mississippi Commission on Wildlife Conservation to which applications must be made. BMR is required to be notified of every proposed activity for which an exemption is claimed and must make its decision on whether to grant the exemption within 30 days. (55) In reviewing and deciding on coastal wetland permit and exemption applications, BMR must review the application against the guidelines for coastal wetlands permits set forth in the Mississippi Coastal Program document (56) and the applicable coastal wetlands use plan as provided in the document, which designates the types of activities allowed in specific coastal wetlands areas. (57)

The Mississippi Coastal Program document provides for the designation of special management areas (SMA's) in the coastal wetlands, in conjunction with local governments, that are in affect, a marriage of coastal wetlands regulation and planned development efforts. This approach can provide added flexibility in dealing with coastal resource use issues in the particular SMA. When adopted as a part of the state's coastal program, a SMA plan will prevail over the more general provision of the state costal plan in wetlands permit decisions. Three types of SMA's (along with specific sites for each type of area) are designated by the Mississippi Coastal Program: (1) industrial and port areas; (2) shorefront access areas; and (3) urban waterfronts. (58)

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The Mississippi Coastal Program requires that all state agencies carry out their responsibilities consistent with the state coastal program. To insure this consistency, the program document sets forth policy coordination procedures governing the agencies, and designates 4 "coastal program agencies" to review agency activities and insure this consistency. If one of these 4 agencies objects to a proposed action, the action cannot go forward. (59)

In the last 12 month statistical period, BMR received 88 coastal wetlands permit applications. The major type of activity for which costal wetlands permit application is made is for residential developments. (60)

BMR and the COE have a joint permit application (for coastal wetlands permits and Section 404 and Section 10 permits)~~,~~ i.e. a permit application to one agency constitutes application to the other agency. This joint application also applies to permits issued by the Bureau of Pollution Control in the state's Department of Natural Resources, and the joint application mechanism was already in existence when the Mississippi Coastal Program went into effect. (61)

C. Louisiana

Wetlands permitting activities in the Louisiana coastal zone (Figure 2) are primarily regulated pursuant to the federally approved Louisiana Coastal Resources Program. The key element of the program is the coastal use permit program established by the State and Local Coastal Resources Management Act (62) and administered by the Coastal Management Section (CMS) in the state's Department of Natural Resources (DNR).

The Act sets forth a general policy of balancing conservation and development of the resources of the statutorily-defined state coastal zone. Pursuant to the Act permits must be obtained from CMS for any use or activity within the coastal zone which has a direct and significant impact on coastal waters. The legislation exempts certain activities from the coastal use permit process, e.g. activities occurring on lands five feet or more above MSL; occurring within fastlands (lands surrounded by publicly owned, maintained, or other validly existing levees or natural formations as of January 1, 1979, or as may be lawfully constructed in the future); agriculture and forestry activities; and construction or maintenance of a dwelling, hotel, restaurant, etc., occurring wholly on lands five feet or more above MSL, or on fastlands, unless the Secretary of DNR determines that a normally exempt activity will have a direct and significant impact on coastal waters. (63)

Allowed to be issued "in lieu" of coastal use permits are permits issued to the statutory authority of the Office of Conservation in DNR for oil and gas and mineral develop-

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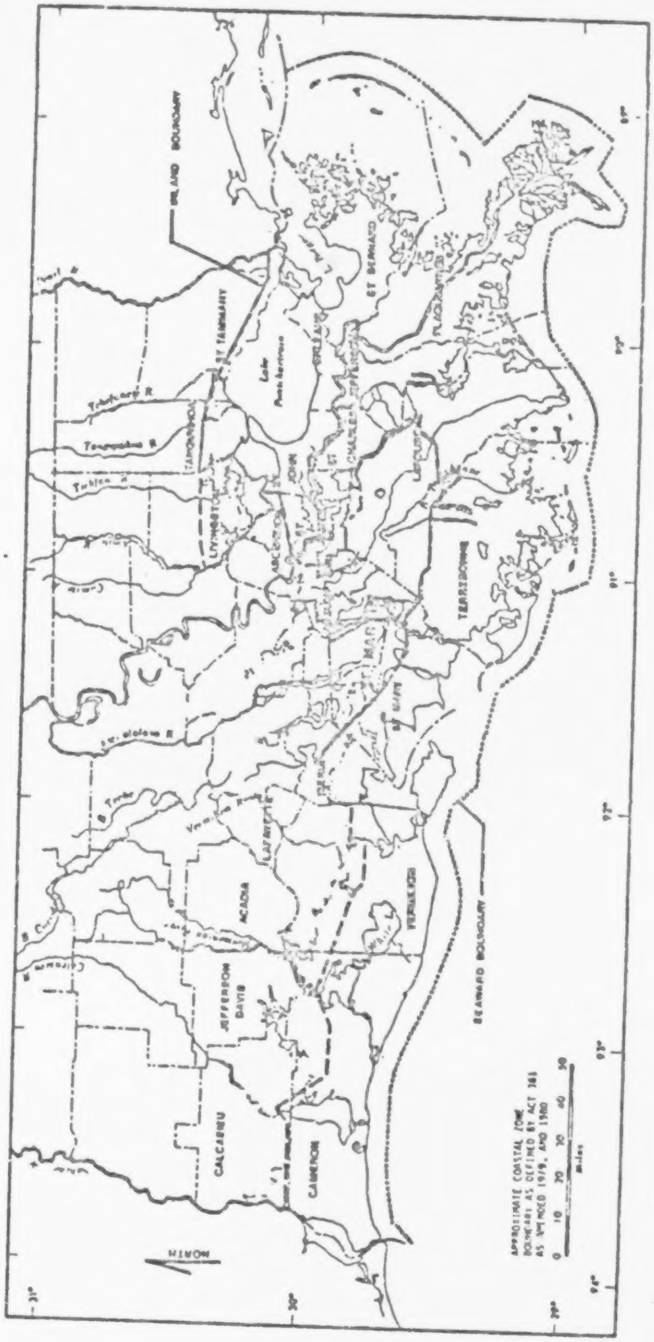
NORTH
INLAND BOUNDARY
SEAWARD BOUNDARY
CALCASIEU
CAMERON
JEFFERSON DAVIS
ACADIA
VERMILION
LAFAYETTE
ST MARY
TERREBONNE
LAFOURCHE
ASCENSION
LIVINGSTON
TANGIPAHOA
ST TAMMANY
ST JOHN
ST CHARLES
JEFFERSON
ORLEANS
ST BERNARD
PLAQUEMINES
Lake Pontchartrain
APPROXIMATE COASTAL ZONE BOUNDARY AS DEFINED BY ACT 361 AS AMENDED 1979, AND 1980
0 10 20 30 40 50
Miles
31°
30°
29°
94°
93°
92°
91°
90°
89°

Figure 2. Louisiana coastal zone.

ment activities. However these activities are required to be consistent with the state coastal resources program. During the state coastal program approval process, a major dispute arose as to whether the state coastal management Act gave CMS authority over "off site" activities related to oil and gas and mineral production, e.g. dredging of canals, channels, etc. to the side, as opposed to "on site" regulation of these activities by the Office of Conservation. The dispute was resolved by the Governor in favor of "off site" regulation by CMS, and the permit relationship between the two agencies is now governed by a memorandum of understanding. (64)

The Act establishes two classes of coastal uses, uses of state concern (e.g., oil and gas activities and all dredge or fill activity associated therewith; any dredge or fill activity that intersects with more than one water body; projects involving the use of state owned lands or water bottoms) and uses of local concern, which are activities that are smaller in scope and impact. (65) The Act provides that local governments can develop programs, which must be approved by CMS, to regulate uses of state concern. As of now, no local programs have been approved, although some are fairly close to approval, so uses of local concern are being presently permitted by CMS. (66)

Permit decisions by CMS must be based on the applications of an extensive set of coastal use guidelines, adopted administratively pursuant to the Act, which are, in effect, performance standards, and on an appropriate balancing of social, environmental, and economic factors, as required by the act and CMS regulations. (67) Generally, coastal use permit applications are required to be processed within forty-two days of receipt. The legislation also provides for the designation of special areas within the coastal zone having unique and valuable characteristics requiring special management procedures and specifically designates areas and facilities subject to the jurisdiction of the Louisiana Offshore Terminal Authority as special areas. (68)

Activities of other state agencies must be carried out in a manner consistent with the Louisiana Coastal Resources Program. A state consistency resolution procedure is established, and the legislation requires a coordinated permitting process involving CMS and other state permitting agencies. This has been partially achieved through memoranda of understanding between the agencies. (69)

CMS is currently receiving 2,000 coastal use permit applications a year, 80 per cent of which are oil and gas related. Of the 1,900 applications received from September 1980-September 1981, 1,100 were issued. Of this number only 12 per cent were issued without conditions which are worked out by negotiations with the applicant during the permit review period. To date, only one costal use permit application has been denied by the state program. The denied application was for a proposed 400,000 gallon creosote storage tank on the West Pearl River, a scenic river under state law. The permit was denied because it did not conform to the coastal use guidelines (in the form of having an unacceptably adverse impact on the water quality of the West Pearl River) and because it did not represent an appropriate balance of social, economic, and environmental factors as required by the act and CMS regulations. A significant number of permit applications are preceded by a pre-application conference, which CMS encourages. (70)

Pursuant to memoranda of understanding, CMS coordinates state agency responses to COE Section 404 and Section 10 permit applications. CMS sits in on a monthly interagency meeting in New Orleans with the New Orleans COE District, U. S. Fish and Wildlife Service, National Marine Fisheries Service, U. S. Envionmental Protection Agency, and the Louisiana Department of Wildlife and Fisheries. These meetings resolve permit disputes and are also designed to avoid duplicative field investigations and to pool information. (71)

State CMS officials feel frustrated in their relationship with the COE. An agreement had been reached between the CMS and the New Orleans COE District for a joint public notice to go into effect on October 1 of this year, after CMS has devoted considerable effort over the past year and one-half and met with much N. O. COE "turf" resistance. In terms of CMS' limited initial dealings with the Vicksburg District, the feeling is that that District doesn't understand coastal zone management. (74)

Two areas in which CMS is seeking to improve the Louisisana Coastal Resources Program are: (1) strengthening the coastal use guidelines to close the loopholes, e.g., the current inclusion of the qualifying phrase "to the maximum extent practicable" which modifies most of the performance standards set out in the guidelines, and make them more enforceable and (2) to move more into special management area designation in order to get away from the evaluation of permit applications on the case-by-case basis by which it operates with the resultant loss of perspective and ability to see cumulative impacts of activities on a certain area. (75)

In conformance with the suggestion by the Vice President's Task Force on Regulatory Relief that the COE expand the use of Sec. 404 general permits, the COE July 22 regulations expanded the issuance of general permits by the COE to cases where the permit would result in avoiding unnecessary duplication of the regulatory control exercised by another federal, state, or local agency. The New Orleans COE District will issue a public notice shortly announcing its proposed general permit to give authorization tofor projects under Sec. 404 (and under Sec. 10 of the Rivers and Harbors Act of 1899) for activities in the part of the Louisiana coastal zone that is within the boundaries of the New Orleans District. This proposal has caused concern among the Federal Sec. 404 consultative agencies who are concerned that such a general permit will severely restrict or eliminate their ability to affect decisions on Sec. 404-type activities in the area covered. CMS is approaching this proposal carefully while trying to assess its impact on CMS activities. (76)

FOOTNOTES

(1) Telephone interviews with Texas resource agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (2) COE regulations defining the extent of "waters of the U.S." for Sec. 404 purposes are at 33 C.F.R. 323.2(a). (3) 33 U.S.C.1251, et seq. (4) 33 U.S.C.403. (5) Telephone interviews with Federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (6) Telephone interview with Federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (7) Telephone interview with Federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (8) 473 F. Supp. 525(W.D.La., 1979): Part II, Env't Rep. Cas. (BNA) 20231 (W.D.La., 1981). (9) 33 U.S.C. 1344(f)(1)(a); 1344(f)(2). (10) Comment made by Federal permit agency official at June 24, 1982, workshop for this project held in Baton Rouge, La., notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (11) Telephone interviews with Federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (12) Telephone interviews with Federal permit agency officials in

June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (13) U.S. Dept. of the Army, Vicksburg Unit, Corps of Engineers, Application No. LMNOD-FE 1522-14-5K21-2 (Bayou Macon) by Westbank Planting Co. and interview with Federal permit agency official in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (14) Telephone interviews with Federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (15) Vice President's Press Release, May 7, 1982, "Announcement of Administrative Reforms of the Regulatory Program Under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act." (16) 33 U.S.C.1344(b). (17) Id. (18) 33 U.S.C.1344, Opinion of the Attorney General of the U.S. on September 5, 1979. (19) Id. (20) Comment made by Federal permit agency official at June 24, 1982, workshop for this project held in Baton Rouge, La., and telephone interviews with Federal permit agency officials in August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (21) Id. (22) Interviews with state and federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. Memorandum of Agreement between the Environmental Protection Agency and the Secretary of the Army, signed July 22, 1982 (copy on file with the author). (23) 40 C.F.R. 230.1, et seq. (24) Id. (25) Id. (26) 40 C.F.R. 230.1. (27) 45 F.R. 45018 (1980). (28) 45 F.R. 70564 (1980). (29) Id. (30) Supra, note 15. (31) 16 U.S.C. 661, et seq. (32) 16 U.S.C. 1451, et seq; 16 U.S.C. 1457. (33) 16 U.S.C. 661, et seq; 44 F.R. 29300 (1979). (34) Supra, note 15. (35) Memorandum of Agreement between the Dept. of Commerce and the Dept. of the Army, signed July 2, 1982; Memorandum of Agreement between the Dept. of the Interior and the Dept. of the Army, signed July 2, 1982 (copies on file with the author). (36) Supra, notes 15 and 35. (37) Supra, notes 20, 27, and 28. (38) Telephone interview with Federal permit agency official in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (39) Supra, note 20. (40) Comments made by Federal permit and resource agency officials at June 24, 1982, workshop for this project held in Baton Rouge, La., and interviews with state and federal permit and resource agency officials in June and August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (41) 46 F.R. 7644 (1981); 40 F.R. 55804 (1975); 40 F.R. 55810 (1975); telephone interviews with federal permit and resource agency officials in June and August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (42) U.S. Dept. of Interior memos to Regional Directors, April 30, 1982; NMFS testimony at U.S. Merchant Marine and Fisheries Comm. hearing in New Orleans, Oct. 5, 1979; interview with federal regulatory official in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program; Coordination Act-Lacey Act: Hearings on Fish and Wildlife Coordination Act and Lacey Act: H.R. 5604 Before the Sub-Committee on Fisheries and Wildlife Conservation and the Environment of the House Committee on Merchant Marine and Fisheries, 96th Congress, 1st and 2nd Sess. (1980), Ser. No. 96-47. (43) "Coastal Zone Management News" (Nautilus Press Newsletter, 198[illegible]). (44) Supra, notes 15, 22, and 35. (45) Telephone interviews with Texas resource management agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program; Notice to potential lessees from Mike Hightower, Director of the Coastal and Uplands Divisions, Texas General Land Office, Notices for Oil and Gas Bids (in the author's files). (46) 16 US 1457. (47) Interviews with state and federal permit agency officials, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (48) Supra, note 1. (49) Id. (50) Id; Texas Coastal Public Lands Act of 1973, Texas Stat. Ann. Sec. 33.001 et seq.; Texas 1980 Year of the Coast, Published by Texas General Land Office, November, 1980. (51) Mississippi Coastal Wetlands Protection Law, Miss. Code Ann. 49-27-1, et seq. (52) Miss. Code Ann. 49-27-5; Water Log, Vol. 1, No. 1, 1981 (Newsletter published by the University of Miss. Sea Grant Legal Program). (53) Miss. Code Ann. 49-27-7. (54) Miss. Code Ann. 49-27-63. (55) Mississippi Coastal Program Document and Final Environmental Impact Statement 1980 (hereinafter referred to as Mississippi Coastal Program Document); Water Log newsletter, supra, note 52. (56) Mississippi Coastal Program Document. (57) Id. (58) Id. (59) Id. (60) Telephone interviews with Mississippi permit agency officials in June and August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (61) Telephone interviews with federal permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (62) La. Rev. Stat. 49:213.1, et seq. (63) Id. (64) "Memorandum of Understanding Between the Coastal Management Section of the Dept. of Natural Resources and the Office of Conservation of the Dept. of Natural Resources," published in the Louisiana Coastal Resources Program Document: Final Environmental Impact Statement, 1980 (hereinafter cited as Louisiana Coastal Resources Program document). (65) La. Rev. Stat. 49:213.5. (66) La. Rev. Stat. 49:213.5; 213.9. (67) La. Rev. Stat. 49:213.11; Louisiana Coastal Resources Program Document. (68) Louisiana Coastal Resources Program Document; La. Rev. Stat. 49:213.10; 213.11. (69) Louisiana Coastal Resources Program Document; La. Rev. Stat. 49:213.13. (70) Interviews with Louisiana permit agency officials in June and August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (71) Id. (72) Id. (73) Id; supra note 15; 47 F.R. 31794 (1982). (74) Interviews with state permit agency officials in June, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program. (75) Id. (76) Supra, note 15; interviews with State permit agency officials and a federal resource agency official in August, 1982, notes of which are on file in the author's office at the LSU Sea Grant Legal Program; draft copy of the proposed general permit on file in the author's office at the LSU Sea Grant Legal Program.

TASKS 3 AND 4

by

L. M. Bahr, Jr. and M. W. Wascom

The primary purpose of this (final) report in the overall case study is to discuss the effectiveness of the existing regulatory structure on wetlands throughout the study area. Much of the following material is necessarily qualitative and subjective, because it is based on the personal experience of the authors, on interviews with representatives of wetland user groups, and on reviews of the very limited printed information on the subject.

This report is organized into five sections. In Section I we briefly discuss the history of wetland regulations. In Section II we discuss the effectiveness of the regulatory structure in the protection of wetlands. In Section III we discuss 404 regulations with respect to bottomland hardwoods. In Section IV we discuss additional matters relevant to wetlands permitting, and in the final section (V) we discuss the future of wetland regulations.

SECTION I. THE HISTORY OF WETLAND REGULATION

Wetland destruction has been fostered by four basic and interrelated factors: (1) widespread ignorance of the functional utility and social importance of wetlands; (2) the general problem of private ownership of a resource, which has a higher value to society at large than to the property owner; (3) the "pioneer ethic" that was a pivotal force in U.S. development; and (4) the availability of cheap fossil fuel that made possible the control of the Mississippi River course and flooding cycles, the rapid clearing of huge expanses of bottomland forest, and the proliferation of major drainage systems.

The first of these factors is illustrated by a variety of government-sponsored subsidies for clearing, draining, and developing wetland habitats. This includes flood protection for those who would otherwise have to gamble their personal resources if they wished to develop flood-prone river bottom and delta areas during dry periods. Agricultural activities have been historically the most heavily subsidized by these programs, but residential and commercial developments, including urban centers, have also spread relentlessly into former wetland areas during the past 100+ years. There are still such inducements to wetland development as a federal income tax writeoff of up to $5,000 for land clearing expenses, and price supports for some crops that displace wetlands. The federal Flood Insurance Act and the federal Disaster Assistance Program induce wetland development by underwriting part of the cost of catastrophic flooding, some of the result of which has been allowing development in flood plains.

A second government-related factor that has contributed to the continuing decline in viable wetlands throughout the study area is basic to environmental management, and it was eloquently described by Garrett Hardin (1968) in his essay "Tragedy of the Commons." Many important components of the natural environment are "common property resources" for which individuals' private cost and benefit calculations do not necessarily coincide with costs and benefits to society as a whole. Hardin described as an example the tendency for individual shepherds to increase the size of their flocks that used a common pasture. This tendency ultimately results in the overgrazing and destruction of the pasture. The only solution to this generic problem is some form of social control at a level higher than the individual, that can make individuals aware of the social costs of their actions. Government can perform this function by regulations, taxes, or subsidies, but effective management requires accurate information on the magnitude of the social costs and benefits involved (Costanza et al. 1982). This information has only recently been developing with respect to the social values of wetlands and the opportunity cost of converting them to other habitats. We are still not able to put precise numbers on wetland function, but individual property owners often benefit considerably more from conversion than from preservation.

A third, historical factor involves the "pioneer ethic" that drove the development of this country from the Atlantic through the South and Mid-West on to the West Coast, and the concept of individual freedom that has been romanticized in the nation's history. Together these notions meant that development, particularly agricultural development by hardy pioneer individuals, was good for the development of the country and provided stability and security. Two romantic remnants with political consequences remain from these American traditions: the concept of the "family farm" and the concept of the ruggedly individualistic Western rancher. These images account for a number of the federal subsidies for agricultural development that exist today.

The fourth factor, cheap abundant energy, was discovered, developed, and harnessed during the last 80 years to alter or eliminate natural flooding cycles within the study area. The building of dams and levees on the Mississippi River system probably represents the single major indirect cause of wetland loss throughout the entire river valley and delta. Energy intensive technological changes that have accompanied the "control" of the river include the development of first steam and later diesel powered drag lines, tractor-driven shear blades that cut large trees at ground level, swamp buggies, and large bulldozers and graders that allow clearing, dredging, canalling, grading, etc., to take place on a massive scale in wetland areas that were formerly almost inaccessible.

The fact that some of the largest oil and gas fields in the country were discovered within the study area has had physical, political, and economic consequences that have led to much additional wetland loss (see Task 1).

SECTION II: EFFECTIVENESS OF WETLANDS REGULATION

Wetland regulation (protection) is a fairly recent role for the Federal government. Until 1972, when both the Section 404 permit program of the Clean Water Act and the federal Coastal Zone Management Act were passed, the federal government was in the position of encouraging the development of wetlands, or at least not discouraging it. This attitude was first expressed in the Swampland Act of 1849, which had the stated intention of granting the federally owned swamp and overflowed lands to the states so that these lands could be leveed, drained, and reclaimed. This orientation was subsequently reaffirmed in 1928, when the (ongoing) Mississippi River and Tributaries Flood Control Project was authorized by Congress, in part, to protect floodplain and wetland developments that had been damaged in the 1927 Mississippi River flood. The trend continued with the federal assistance program for agricultural development (including Farmers Home Administration and Soil Conservation flood insurance protection programs) and federal disaster assistance programs, all of which have had the result of directly and indirectly encouraging agricultural and other development in flood prone areas.

Since the passage of the Clean Water Act in 1972, with its Section 404 provision against dredge spoil disposal in navigable waters, the position of the U. S. Government has become extremely ambivalent with respect to wetlands. On one hand there are government programs that have the effect of encouraging wetland reclamation, as noted above, while on the other hand there are government programs, such as the 404 program, that are intended to weigh wetland development against the natural function and value of wetlands. This ambiguity is in part the result of legislative efforts by the Congress to accommodate the needs and interests of different segments of society.

The passage of 404 accompanied a national environmental movement that publicized some of the previously unrecognized "natural work services" that are performed (free of cost) by wetlands. One of these services is the prevention of erosion that accompanies the flow of water across unvegetated land. The Clean Water Act thus indirectly addresses the problem of siltation and excess turbidity in natural water bodies by regulating wetland alteration that would increase erosion.

There is still debate as to whether Section 404 was intended only to prohibit spoil disposal into open waters of the U.S., or whether it was intended more broadly to regulate the clearing and drainage of wetlands. The legislative history of the Clean Water Act indicates that Section 404 was to do both. There is no question, however, about the attitude of the American public on the issue of proposed changes to the Clean water Act. A recent Harris poll showed overwhelming support for retaining and even strengthening the act to prevent further degradation of water quality.

Effects of Wetland Regulations in the Study Area

The two most significant and extensive activities subject to wetlands regulation in Texas, Louisiana, and Mississippi are oil and gas exploration and development in the coastal areas of these states, and the clearing and conversion of bottomland hardwood areas to soybean fields. These activities are discussed in separate subsections below.

I. Oil and Gas Exploration and Development in Coastal Areas

Wetlands regulation is currently an important factor in the conduction of oil and gas exploration and development in the coastal areas of Louisiana and Texas. Among the activities that are regulated are the dredging of pipeline canals and access canals to drilling sites. The regulations are especially relevant in Louisiana, which has a federally-approved coastal zone management program, and in which there is much evidence linking oil and gas activities to chronic wetland erosion (see Task 1). Although oil and gas activities are only beginning in Mississippi, it is probable that wetland regulations will eventually play an important role, in part because Mississippi also has an approved CZM program.

A. Section 404 Permitting

The necessity of obtaining a Section 404 permit for oil and gas activities in coastal Louisiana and Texas presumably creates an (indeterminate) reduction in or modification of projects that would occur in the absence of regulation. In addition, Section 404 permitting has affected coastal oil and gas activities in these states through the interagency consultative process established by the Fish and Wildlife Coordination Act (FWCA) and Section 404(q) of the Clean Water Act (CWA). In Louisiana and Texas, the National Marine fisheries Service and the U. S. Fish and Wildlife Service have been the primary participants under FWCA with respect to oil and gas related Section 404 permits, with the state fish and wildlife agencies playing a much less significant role. Region VI of the Environmental Protection Agency sometimes recommends that a Sec. 404 permit not be issued unless certain conditions are incorporated in the permit. The New Orleans and Galveston COE districts sometimes require a permit applicant to accept COE recommendations on minimizing environmental damage of a proposed oil and gas related project. Figure 1 illustrates the different jurisdictional boundaries of some of the federal agencies that play a role in wetlands regulation in the study area. The COE districts are not shown because their boundaries are currently changing and the new boundaries are not available at this time.

Unlike the situation with bottomland hardwood habitat (see below) the general question of COE Sec. 404 jurisdiction over oil and gas activities in these coastal areas is not an issue. Some oil and gas industry officials have complained about the requirements for mitigation of fish and wildlife habitat losses due to Sec. 404 activities that are imposed by NMFS and/or FWS by the New Orleans or Galveston COE Districts. Generally stated, the term "mitigation" for habitat loss as applied by these agencies in a Sec. 404 context encompasses three approaches: (1) revision of the applicant's proposed project, so that potential wetland habitat damage is minimized before the project is carried out; (2) restoration of wetland habitat damaged at the project site after completion (to the extent that restoration is feasible); and (3) if neither of these measures are sufficient to offset the wetland habitat damage, then some form of compensation is required. This could be the enhancement of existing wetland habitat, or creation of new habitat. "Mitigation" actually required on occasion for oil and gas

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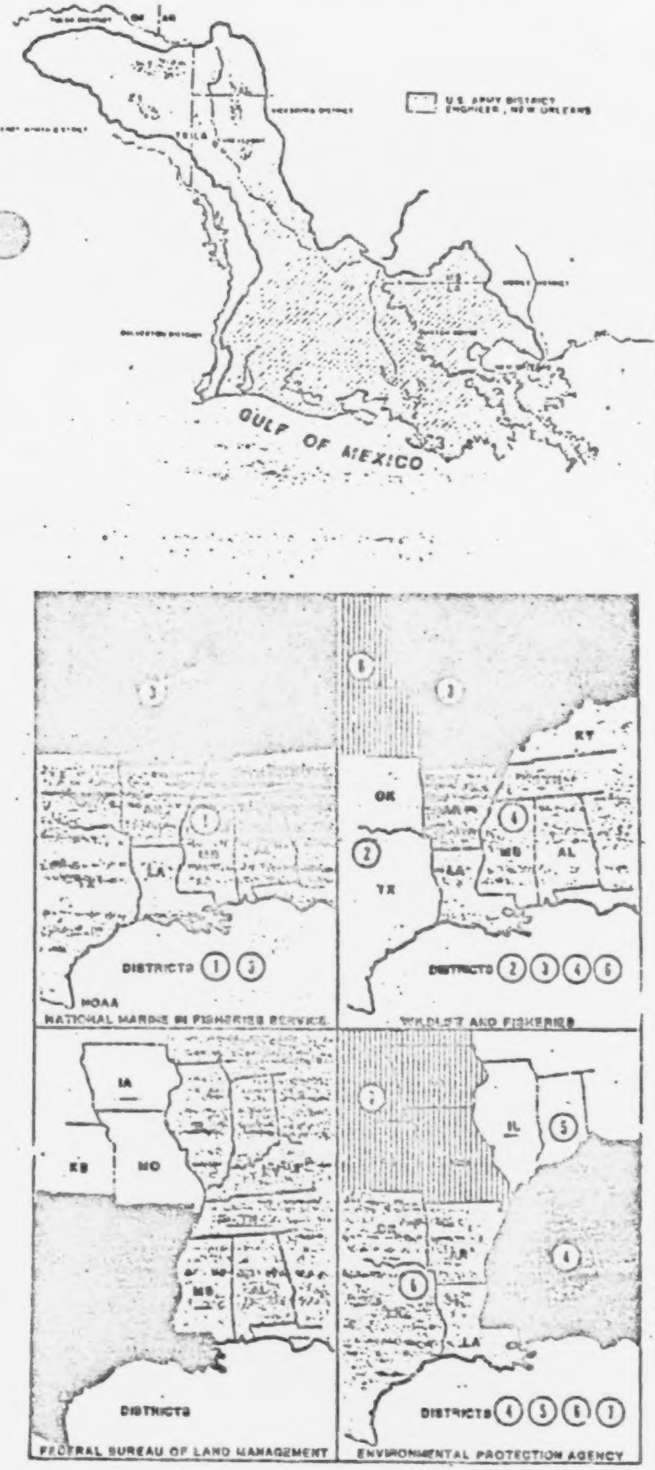
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ENVIRONMENTAL PROTECTION AGENCY

Figure 1. Jurisdictional regions of various wetland permitting and consultative agencies of the U.S. government.

Sec. 404 activities in the Louisiana and Texas coastal zones has included such requirements as the backfilling of pipeline canals in marshland and the alignment of access canals to drilling sites so as to maximize use of existing canals and natural channels.

A common complaint by applicants is the delay in issuance of a Sec. 404 permit by the COE because of interagency disputes concerning mitigation and other conditions that are recommended to be included in the proposed activity. As pointed out in Task 2, the agencies feel that the delay in issuance is often due to the applicant's failure to respond to correspondence or to meet with agency officials to discuss the project and proposed mitigation conditions. The agencies involved in the permit consultative process also point out that they are always ready to meet with an applicant prior to the application for a Sec. 404 permit in order to work out differences. A recent example of the cooperative attitude shown by the agencies involves a recent meeting with representatives of the major landholding companies in Louisiana. This meeting was held to identify mitigation measures for their incorporation into projects requiring 404 permits, primarily those involving excavation of access canals through wetlands. The landowners have agreed to develop written management plans. Individual features of these plans can be implemented as mitigation measures to offset permit-related damages to productive wetlands.

The Sec. 404 reforms mandated by the Vice President's Task Force on Regulatory Relief, and carried out, in part, by the new COE 404 regulations promulgated on July 22, 1982, will significantly limit the time within which a COE 404 decision must be made. The changes will also affect the interagency consultative process. The impact assessment of a proposed 404 activity will have to be made much more quickly, as will mitigation recommendations. If a COE District refuses to require the recommended mitigation, it will also be much more difficult to appeal this refusal to a higher interagency level.

The COE July 22 regulations expanded the issuance of general permits (in conformance with the suggestion by the Vice President's Task Force) to cases where the permit would result in avoiding unnecessary duplication of the regulatory control exercised by another federal, state, or local agency. The New Orleans COE District will issue a public notice shortly announcing its proposed permit for the general authorization for projects under Sec. 404 (and Sec. 10 of the Rivers and Harbors Act of 1899) for activities in the part of the Louisiana Coastal Zone which is within the boundaries of the New Orleans District. This proposal is causing concern among the federal Sec. 404 consultative agencies that are apprehensive that such a general permit will severely restrict or eliminate their ability to affect decisions on 404-type activities in the area covered.

5. State Regulation

Texas

As pointed out in Task 2, Texas has neither a federally-approved coastal management program, nor a state regulatory program addressing 404 type activities on private land. The state does have a limited permit program of this type with respect to activities on state-owned land and waterbottoms in the coastal area. Thus, in Texas the 404 program functions as the only comprehensive wetlands regulation program.

Louisiana

The Louisiana Department of Natural Resources Coastal Management Section (CMS) is deeply involved in the regulation of 404 activities in the Louisiana coastal zone that involve oil and gas activities. Applications for coastal use permits are reviewed against extensive performance standard guidelines, including guidelines for "linear facilities" e.g., pipelines, cannels and channels, and a specific set of guidelines for directed oil and gas activities. Very few of the guidelines are absolute prohibitions on activities; most are conditioned by the phrase "to the maximum extent practicable."

CMS' mitigation policy is the same three step approach as that generally used by NMFS and FWS. Although only one coastal use permit application has been denied during the nearly two year lifetime of the Louisiana coastal management program, the real effect of the program has been in placing conditions on 404-type activities (pursuant to the coastal use guidelines). A secondary, but quite significant feature of the CMS program is that the coastal regulatory activities of other state agencies (including oil and gas permits issued by the Office of Conservation "in lieu" of coastal use permits) are required to be consistent with those of CMS.

Because of a small staff and a large volume of permit applications, CMS has found it difficult to assess the cumulative affects of its permit decisions. The development of special management areas, as provided for by state legislation, is one CMS plan to address this problem. This plan would provide for the development of special management procedures and policies in discrete coastal areas, including consideration of cumulative impacts and a greater level of predictability on permit decisions in each area.

On the local level, CMS regulations require a parish that is developing coastal management plans to divide the parish into management units with similar environmental and resource characteristics, and to develop management policies for these units that deal with specific sites. Such local programs would also provide for greater predictability of permit decisions and increased potential for addressing cumulative affects.

Under the consistency provisions of the federal Coastal Zone Management Act of 1972, applicants for Sec. 404 permits must certify to the COE that the proposed activity will be carried out pursuant to the Louisiana Coastal Management Program, and send a copy of this certification to CMS. Also pursuant to this authority, CMS is authorized to inform the COE as to whether or not it agrees with the consistency certification made by the 404 permit applicant. If CMS disagrees with the applicant's certification, the COE cannot issue a Sec. 404 permit for the activity. The New Orleans and Vicksburg COE Districts will not issue a 404 permit for Louisiana's coastal zone unless CMS issues a coastal use permit for the activity. In effect, they view CMS' coastal use permit decision on the proposed activity as CMS' consistency determination.

Pursuant to its statutory authority to coordinate permit handling, and its consistency authority under federal law, CMS coordinates the state's comments to the COE on Sec. 404 permits (including those by the Louisiana Department of Wildlife and Fisheries).

Mississippi

In July, 1982, Mississippi held its first oil and gas lease sale for offshore tracts. This event opened a new era of coastal activity in Mississippi. As oil and gas development increases, Sec. 404 regulations (through the Mobile COE District) and the Mississippi Coastal Program, which is federally approved, will play an increasing role. Although oil and gas activities affecting Mississippi's coastal wetlands are gnerally exempt from coastal zone management permitting, these activities are stipulated to be conducted in a manner consistent with the public policy set forth in the state's Coastal Wetlands Protection Law. This is the primary authority for coastal management program permits, which are supposed to prevent the destruction of Mississippi coastal wetlands except where a specific alteration of the wetlands would serve a higher public interest (as determined by the program). As a means of ensuring that coastal oil and gas activities are consistent with the Mississippi Coastal Program, guidelines are set forth that specify conditions and performance standards pursuant to which these activities must be conducted in order to be consistent with the Program.

Unlike the Louisiana coastal management guidelines, the Mississippi guidelines are written in mandatory language ("shall") without the qualifying phrase "to the maximum extent practicable." Quite unlike the situation in Louisiana, coastal oil and gas activity in Mississippi has been minimal so far. It is too early to tell how effectively the guidelines will be applied and what their actual impact on these activities will be.

The consistency provisions of the Federal Coastal Management Act of 1972 also apply in Mississippi. Thus the Mississippi Coastal Program has significant review authority over Sec. 404 permit applications, including those associated with oil and gas.

Like the Louisiana program, the Mississippi Coastal Management Program also provides for the establishment of special management areas. These areas allow for management policies tailored to the needs of the area so designated. The use of the special management area concept could provide the Mississippi Coastal Program with flexibility in dealing with coastal oil and gas development in specific sites, if the need arises.

SECTION III. BOTTOMLAND HARDWOOD CONVERSION AND 404 REGULATION

The regulation of the clearing and conversion of bottomland hardwoods in the three state study area is, for all practical purposes, significant only in terms of Sec. 404 permitting. Coastal zone management permitting is innapplicable because most of the bottomland hardwood habitat is outside of the official Louisiana and Mississippi coastal zones. This is a problem that results from defining the coastal boundaries too narrowly. For example, there are hard scientific data that demonstrate that the functional coastal zone in Louisiana extends far inland, including all of the Barataria Basin and much of the Atchafalaya Basin, despite the exclusion of much of these regions from the official boundary (c.f. McIntyre et al 1975) In Mississippi, the coastal zone management plan is limited only to salt marsh areas, thereby eliminating most of the Pearl River Basin, which is intimately connected with the coastal ecosystem.

As pointed out in Task 2, because of the COE decision at the national level to limit the legal application of the Avoyelles Sportsmen's League decision to the Western (Federal) Judicial District, only the Vicksburg and New Orleans COE Districts are affected in terms of 404 permitting. Each of these districts has jurisdiction over a portion of the Louisiana area that is in the Western Judicial District. The Vicksburg District currently encompasses the largest area of bottomland hardwood habitat, and its jurisdictional area will increase by the end of the year when a significant portion of the area currently regulated by New Orleans is transferred to the Vicksburg District.

The major issue concerning Sec. 404 application to the clearing and conversion of bottomland hardwood area has been what areas constitute "wetlands." Although the issue has been relevant primarily with respect to the clearing of forested wetland areas for conversion to agricultural use, it has been of some concern to those involved in the forestry industry also. The "special case" mechanism, whereby the COE automatically refers permits containing one or more of a delineated forest types to the EPA for a 404 wetlands jurisdictional call, will aid applicants and agencies alike. There will be greater predictability as to whether land clearing on a particular tract will require a Sec. 404 permit. This "special case" procedure and the COE decision to limit the application of the Avoyelles case mean that 404 requirements are being applied to the clearing and conversion of bottomland hardwood forests only in Louisiana and Mississippi. This anomaly must be rectified and a decision must be made about applying Sec. 404 consistently throughout the country.

The Vice President's Task Force on Regulatory Relief has mandated that the COE and EPA, in consultation with other expert agencies, develop new and more specific criteria defining the jurisdictional scope of the Sec. 404 program, and specifying the types of wetlands that are (and are not) appropriately covered under the Clean Water Act. This effort will no doubt include an extensive public debate centered on the 404 botomland hardwood issue.

SECTION IV. TWO OTHER MATTERS RELEVANT TO THE EFFECT

OF WETLANDS PERMITTING IN THE STUDY AREA

A. Federal Programs Relative to Agricultural Use of Wetlands

U.S. government policy has already been described as taking two different approaches to wetlands; some programs stimulate the development of wetlands while others attempt to minimize unnecessary development. In short, there has not been a consistent view of either what constitutes wetlands or of what the national policy toward wetlands should be. A prime example of this ambivalent approach involves agriculture.

Because of different federal programs with different "missions," one agency might look at a tract of land and see a wetlands area subject to, for example, Sec. 404 regulation and mitigation requirements. Another agency might view the same tract as prime farmland, that should be subject to a form of federal agricultural assistance for development. One example of the resolution of these different approaches to land use involves the SCS in the Department of Agriculture and the FWS in the Department of Interior. SCS provides assistance to farmers in the form of soil surveys, soil and water conservation principles, and engineering services. A 1981 publication by SCS contains the statement that "SCS does not provide assistance in draining wetlands to create new cropland areas." SCS regulations include "wetlands preservation" language and they quote a FWS circular on wetland types as support. The problem is that the quote (from circular 39) was originally published in 1956 (reissued in 1971), and the circular was replaced in 1979 by a classification system that uses more sophisticated criteria for identifying wetlands (Cowardin et al. 1979). The 1979 circular uses vegetation type, soil type, and/or hydrology to classify wetlands. Under the original FWS circular, if a tract of seasonally flooded bottomland hardwood forest is cleared it is no longer considered wetland because of the absence of wetland vegetation. Under the 1979 circular, clearing the land does not abridge its wetland status, because its soil type remains unchanged. SCS regulations published on August 6, 1982 make it clear that SCS has been working with FWS to test the new FWS classification system in ten states, including Louisiana, and expects to adopt the FWS system relatively soon. Adoption of the FWS wetland classification system by the SCS would be an important first step in achieving a consistent federal approach toward wetlands, especially with respect to bottomland hardwoods and Sec. 404 regulations.

B. Cumulative Impacts of Wetland Activities, and the Effectiveness of Regulations

Most observers seem to agree that the Sec. 404 permitting program and the Louisiana and Mississippi state coastal management programs have succeeded in retarding the rate of wetland loss in Texas, Louisiana, and Mississippi. These programs include the conditions placed on permitted activities as their applications go through the interagency consultative process. In other words, if no regulatory structure were in place there would presumably be less marsh and forested wetland, more open canals, roadways, and soybean fields, and more secondary development in areas that are now wetlands. An example of a major project through Louisiana wetlands that was greatly modified by the application of wetlands regulations is the proposed New Orleans beltway (I-410) two thirds of which (42 miles) were deleted from the project. This highway would have resulted in the direct destruction of a large area of wetland (swampforest and marsh). In addition, it was successfully argued by the plaintiffs in a suit brought against the Louisiana Department of Transportation and Development and the Federal Highway Administration that secondary impacts from induced development would result in enormous additional losses (Hammond 1978).

Despite such examples of the usefulness of wetlands regulations in protecting coastal wetlands, there is very little information on the cumulative effectiveness of these regulatory programs in terms of ameliorating long term environmental damage. The COE is collecting some information on cumulative impacts of projects, and the effectiveness of regulations, but the work is incomplete. The Louisiana

Coastal Management Section recognizes the importance of assessing cumulative impacts, and understands that handling projects on a case-by-case basis is not the optimal way to go.

The bottom line is, of course, that wetlands in Louisiana are being lost faster than ever (see Task 1). The development of a methodology for assessment of the cumulative impacts of various projects should have the highest priority.

Since the implementation of wetland regulation on the part of both federal and state governments, there has not been a significant reduction in the rate of wetland loss in the study area. The complex nature of the causes of wetland loss, however, (see Task 1) argue against a blanket indictment of the regulation apparatus.

As pointed out in Task 1, a major (but unquantified) portion of the wetland loss in the study area is the result of the overall Mississippi River flood control system. This system was implemented long before 1972, and it is still under completion in the sense that there is a continual need to correct problems that arise within this huge man-made system, such as raising levees and correcting local flooding caused by the system. By dramatically reducing seasonal flooding and sedimentation throughout the alluvial valley and deltaic zone of the Mississippi River two problems have occurred: (1) the development of formerly flood-prone areas has become feasible throughout the study area and (2) sedimentation has been unable to keep up with subsidence in the MDPR, and to a lesser extent in the MCPR.

SECTION VI. PROGNOSIS FOR THE FUTURE

The natural processes that may aggravate wetland loss in the future include particularly the global warming trend that is forecast by some scientists. According to the so-called Camp Century cycle theory of global temperature change we are presently at the bottom of a cooling trend, and about to enter a long term warming period. At the same time, because of cultural increases to atmospheric CO2 we may add significantly to the natural warming. If sea level were to rise 5 feet along the northern gulf coast during the next century, as predicted by some, all management solutions to land loss would be futile!

The state of Louisiana is officially acknowledging for the first time that there has been a significant environmental cost associated with oil and gas production in the coastal zone. A "First Use Tax" was passed in 1979 during the administration of Governor Edwards, as a means of reimbursing the state for a portion of this damage. This tax would have applied to the pipeline companies that transported gas produced offshore across the coastline. The justification was based on the fact that barrier islands are eroding and state wetlands are being lost partly as a result of pipeline canals. The law was subsequently declared unconstitutional because it only applied to out-of-state consumers. In 1982 Governor Treen proposed a similar "Coastal Wetlands Environmental Levy" that would tax all oil and gas transported through the coastal zone. This bill was recently defeated in the Louisiana House of Representatives. Although both of these pieces of legislation were unsuccessful they may represent a turning point in the official state position on wetland value.

One of the most intransigent problems for environmental management is the evaluation of environmental costs in general, and the costs of wetland loss in particular. Most of the services performed by wetlands are not recognized in our economic system. In addition, there are major differences between the costs and benefits of wetland alteration for society in general and for landowners in particular. Thus there is at present little economic incentive for landowners to preserve wetlands in their natural state, even though society may benefit most from this course in the long run.

Only eight years ago, much interest and some controversy was created by a scientific paper that suggested that the services performed for society by wetlands could be evaluated in dollar terms, and that this value exceeded the market value of many highland areas (Gosselink, et al 1974). Since the publication of this paper, another estimate of the value of wetlands, specific for the MDPR, has been published (Humphrey et al. 1978), and further advances in the evaluation of natural systems have been made. The concept of evaluating wetland services in energy terms, that can also be expressed in dollars, was discussed by Day et al. (1981), Costanza (1981), and Costanza and Neill (1981). This area of research is indeed promising, and it will presumably affect future environmental management strategies.

The anticipated deregulation of oil and gas prices will undoubtedly be accompanied by dramatic increases in the market prices of these resources. This will, in turn, lead to increased production efforts in coastal wetlands. Some secondary development of old fields is occurring at present, and canal permit requests are not declining, despite the high density of existing canals (La. Dept. of Nat. Res. 1982). One of the problems that has led to the inordinate number of canals around particular fields is that different companies rarely use the same canals. Another problem is the reluctance of oil and gas producers to consider alternative exploration and drilling methods, such as the use of hydrofoils and directional drilling (Craig and Day 1981). Some of these methods may be more expensive in terms of production, even though they may save money in the long run in terms of environmental damage. Oil company representatives often say that directional drilling is technically infeasible in many inshore areas, but this technique is routinely used offshore.

Another problem is the increase in wildcatting that accompanies price increases. A wildcat well cannot at present be drilled within several miles of exploration or production drill sites. This restriction results in the incentive to dredge new canals in pristine wetland areas. One of the greatest problems, however, is the historical reluctance of regulatory authorities to deny permits, despite evidence that significant environmental damage would result.

Apparently, some potential developers of wetlands perceive the national political climate as favoring the relaxation of regulations. This perception should be considered in the evaluation of the effectiveness of the present regulatory structure.

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